December 1982
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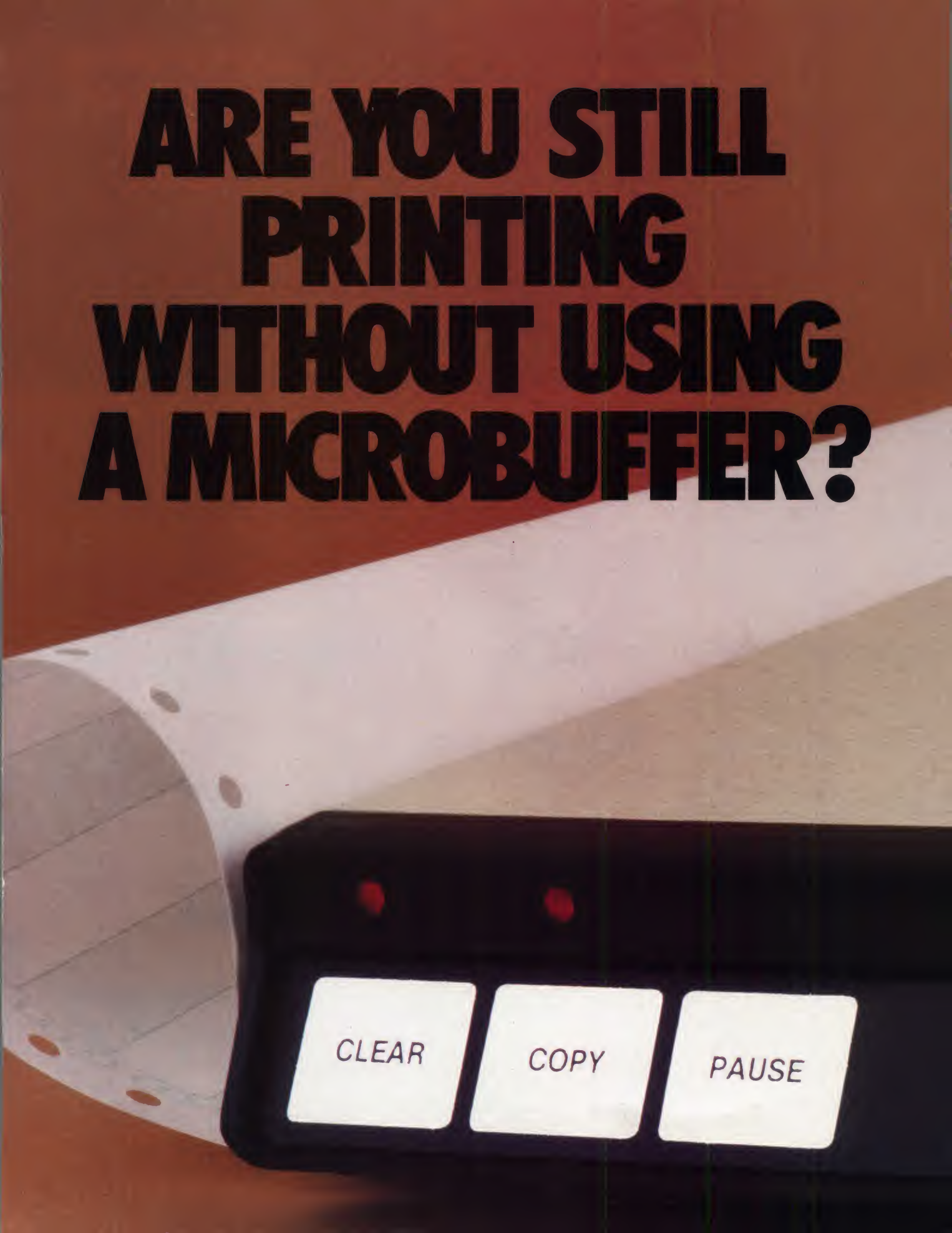

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CIRCLE 166 ON READER SERVICE CARD

in this issue...

evaluations & profiles

16 **Tymshare Scanset** ..... *Anderson*
Terminal velocity

20 **Communitree** ..... *Coffey*
The start of a new wave in human communication

30 **New Processors for The Apple** ..... *Coffey*
Better performance and added features

48 **Colecovision** ..... *Linzmayer*
New kid on the block

58 **Stocking Stuffers** ..... *Anderson, Archibald*
18 games for gift giving *Linzmayer, McNamee*

100 **Bang & Olufsen Beosystem 8000** ..... *Ahl*
A price-is-no-object hi-fi stereo system

114 **Electric Duet** ..... *Ahl*
Music synthesis with software

137 **Talk is Getting Cheaper** ..... *Anderson*
Three approaches to speech synthesis

148 **The Color Computer Speaks** ..... *Norman*
Compuvoice from Radio Shack

articles

120 **Speech! Speech!** ..... *McComb*
A close look at speech synthesis

156 **Automatalk** ..... *Prince*
A progress report on robotics

167 **Inventing The Future** ..... *Williams*
An historian's view

180 **Computers & Creativity** ..... *Ten Dyke*
Can computers create?

200 **Experience, Experiments and Intelligence** ..... *Berry*
A guest editorial

204 **Burn-Out To Born Again** ..... *Urbanowicz*
Atari makes a convert

214 **Logo Ideas** ..... *Lawler*
Single-key interfaces

216 **The Countess and The Computer** ..... *Gilpin*
Part II

233 **Rediscovering Level II** ..... *Spahitz*
Programming techniques for TRS-80 Model I

243 **Pilot Tutorial** ..... *Smith*
Part II

254 **Improving Readability** ..... *Lundeen*
Make your programs easier to use

256 **Cerf vs. Mimura** ..... *Cerf*
A championship game of Othello

fiction & foolishness

179 **Die Wahrheit** ..... *Jaeger*

213 **Computer Carols** ..... *Anderson*

264 **Picturing Infinity** ..... *Payack*

applications & software

268 **Parallel Processing** ..... *Parent*

284 **Searching Techniques** ..... *Mitchell*
How to find it

298 **The Monkey and The Hunter** ..... *Rogowski*
A computer solution to a classic problem

312 **Creating A Hole in Applesoft Basic** ..... *Parrott*

320 **Keeping Track of Variable Names** ..... *McMillan*
An Applesoft utility

322 **Output Au Naturel** ..... *Lowenstein*
Making text "look right"

326 **A Scrolling Routine for CBM/PET** ..... *Bruey*
An easy way to examine output listings

328 **Pocket Computer Fun** ..... *Rollins*
A maze program that fits in your pocket

330 **Twonky Revisited** ..... *Hertel*
New version of an old favorite for TRS-80

336 **Checkers** ..... *White*
Programming a strategy game

344 **Standard Keyboard For The Atari 400** ..... *Noskowicz*
Build it yourself

346 **Love Potency Meter** ..... *Ahl*
Build an analog to digital interface

departments

6 **Input/Output** ..... *Readers*

8 **Notices** ..... *Fee*

10 **Dateline: Tomorrow** ..... *Ahl*

334 **Short Programs** ..... *Humble & Disque*
For TRS-80 and Atari

350 **New Products** ..... *Anderson & Coffey*

360 **Software Legal Forum** ..... *Novick*
Insuring your computer

364 **Apple Cart** ..... *Carpenter*

370 **Outpost: Atari** ..... *Anderson*

378 **The Graph Paper** ..... *Lubar*

384 **IBM Images** ..... *Fastie*

396 **Personal Electronic Transactions** ..... *Yob*
Directory of products for the VIC

408 **TRS-80 Strings** ..... *Gray*

416 **Book Reviews** ..... *Gray*

430 **Index To Advertisers** .....

December, 1982
Volume 8, Number 12

BPA MEMBER MTA

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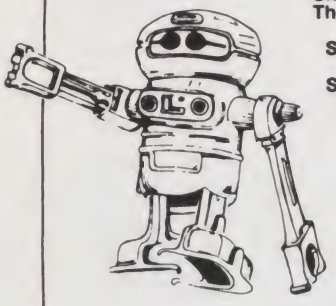

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Eliminating Bad Vibes

Dear Editor:

I have recently purchased a System Saver fan by Kensington Software. Although the fan works as advertised, I have made two improvements that your readers may be interested in.

First I covered the vent slots on the right side of my Apple with a section of air conditioning filter. This prevents dust from being drawn across the inside of the computer. The filter was attached with duct tape to the outside of the computer.

The second improvement was to place 1/8" thick foam rubber between the part of the fan case and the computer that come in contact with each other. This minimizes vibration.

Robert Gershowitz
76-51 169 Street
Flushing, NY 11366

Turtle Bottleneck

Dear Editor:

The Applesoft Turtlegraphics Interpreter featured in the July 1982 issue is an excellent program and a valuable addition to my library. However, I did have one slight problem with it.

When I attempted to draw a line straight down using the MOVE command, (by setting the turtle's angle to 180) the line never turned out quite straight. A couple dots at the end would always be plotted one column to the left.

After experimenting with the program for a while, I found the problem to be the way in which the MOVE subroutine computes the amount of X-axis movement. As originally written, the variable DX would sometimes be ever so slightly too small, causing the above mentioned problem. This can be corrected by changing line 3010 to read:

3010 DX = INT (DIST * SIN (TA) + .5): DY = INT (DIST * COS (TA) + .5)

I would like to thank *Creative Computing* for continually pubishing quality Apple programs. I am also very thankful for David Lubar's new column, "The Graph Paper." I am already looking forward to the next issue.

Matthew Storch
Box 133, RD 1
Avonmore, PA 15618

Acceleration of a Sort

Dear Editor:

I found Mark Pelczarski's "A Modular Data Base for the Apple" (September 1982 issue, page 146) to be extremely useful. I have adapted it to my personal filing needs—something impossible to do with commercial "locked" programs.

However, one very slight modification in the program makes such a dramatic improvement that I really must write about it. As written, the sort routine is much slower than it should be, requiring 14 seconds to alphabetize 20 strings, 90 seconds for 50, and 24 minutes for 200 items. A simple Applesoft procedure shortens these times by almost 90%, to 2, 12, and 190 seconds respectively.

First, remove the print statement in the middle of the sort (line 7122). This shortens the time by 20%. Then modify lines 7070 to 7180 so that two different routines are involved, one for ascending and the other (if desired) for descending order. The removal of the branching in line 7125 will shorten the sort time by a factor of six.

With these modifications, files with up to several hundred records can be handled by the Pelczarski program. The practical limit depends not only on sort time but also on the disk capacity and the time required to search for records on the disk, as with all disk-based filing systems.

Peter P. Berlow
2062 Vendome Ave.
Montreal, Quebec H4A 3M5
Canada

Justifiable Adjustment

Dear Editor:

I just finished typing in Bruno Wolff's "Pseudo Word Processor" from your June issue. After finding that the program works quite well, I decided to write a subroutine to give the program right margin justification.

Just add the lines below to the program and everything should come out just right.

```
751 If Len (A$(J)) < 71 and Len (A$(J)) > 60
    Then Gosub 5000

5000 R = 7

5010 If Len (A$(J)) = 71 Then Return

5020 If Mid$ (A$(J),R,1) < > Chr$ (32) Then 5130

5100 C$ = Left$ (A$(J),R): L = Len (A$(J))

5110 B$ = " " + Right$ (A$(J),L-R)

5120 R = R + 1: A$(J) = C$ + B$

5130 R = R + 1: Goto 5010
```

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PCW Chess Tournament

The Third Personal Computer World Microcomputer Chess Tournament held at Barbican Centre in London on September 9-12, 1982 was won by a private entry. Michael Johnson and David Johnson (6 out of 7) proved too strong for the rest of the field. Their program, called Advance 2.4, ran on a homemade bitslice machine. They were awarded the trophy for first place as well as the best amateur program trophy. This was accompanied by a cash prize of £150. Second prize of £50 was won by Mark Bryant with a program called White Knight Mark Ten (3 1/2 out of 7).

The tournament was a seven round Swiss event. Fourteen competitors entered compared to twelve last year. Best commercial entry was David Levy's La Regence, a sensory board machine designed by Intelligent Software (5 out of 7).

Four commercial entries competed. The others were Bogel (4 out of 7) developed by the Hamburg company Omikron; Comchess entered by the Dublin company Waltham Electronics (2 1/2 out of 7); and Spectrum Chess developed by Arctic Computers (1 1/2 out of 7).

The criterion for classifying a program as commercial was that it was either on sale at the time of entry or would be available in the shops by December 31, 1982.

Corrections

The proper address to receive more information on the *Savvy* information handling system (October 1982, page 182) is: Savvy Marketing International, 100 South Ellsworth St., 9th Floor, San Mateo, CA 94401. (415) 340-0335.

The price and address for the Dotsy Printer Center (October 1982, page 168) are incorrect. The price is $1495, and the address is: Metaframe Computer Corporation, Riverside St., Nashua, NH 03062. (603) 880-3005.

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CIRCLE 199 ON READER SERVICE CARD

David H. Ahl

VIDEO GAMES FOUND HARMFUL BY BAHRAIN DOCTOR

I recently travelled around the world with stops in Tasmania (9th Australian Computer Conference), Singapore, Bahrain and London (Personal Computer World Show).

Bahrain is an island in the Persian Gulf off the coast of Saudi Arabia. With the unrest in Lebanon, Bahrain has become the banking center of the Middle East. However, in many ways it clings to ancient Arab traditions with civilization on the island dating back to 2700 B.C.

The following is an excerpt of an article which appeared in a Bahrain newspaper September 3, 1982.

> Dr. Andrew McQuitty, a Briton who now works in Bahrain, has warned of the danger of epileptic fits caused by certain flashing sequences--even among people with little or no history of epilepsy.
>
> He cited the example--quoted recently in the British Medical Journal--of a 17-year old girl who suffered a fit after a multi-colored flashing sequence in a video game called "Dark Warrior."
>
> Her father was a video games maintenance engineer and she usually played machines of different types for up to two hours a day--but only this particular sequence precipitated epilepsy.
>
> The girl had no previous history of fits or convulsions nor did her family.
>
> Since the article was published, a number of other cases have been reported.
>
> A 17-year old girl who had previously had one fit--not related to video games--suffered an attack while playing a game called "Dune Buggy."
>
> It is well-known in medical circles that flashing lights, for example strobes in a disco or even a flickering TV, can trigger epilepsy in people who are susceptible," said Dr. McQuitty, who is investigating the situation in Bahrain.
>
> "The home video industry appears to be another cause--possibly in people who would not normally be prone to any form of epilepsy," he says.

MEANWHILE, SINGAPORE ACTS TO CLOSE ALL VIDEO GAME ARCADES

The Singapore government announced on September 2, 1982 that all amusement centers with electronic and video games will be closed within the next twelve months.

The Ministry of Culture issued a statement saying the 64 amusement centers throughout the country "have undesirable influences on school children."

SINGAPORE SCHOOLS WELCOME PERSONAL COMPUTERS

A feature article in The Straits Times (Singapore) described how personal computers, mainly Apples and TRS-80's are increasingly being used in classrooms throughout Singapore.

While the American School has been using computers for several years, it is only recently that they have begun to creep into regular Singapore schools. Applications are much the same as they are in the United States--problem solving and drill and practice in mathematics, simulations in science and social studies, and occasional applications in other subject areas.

Not only are schools using computers, but computer literacy is a nationwide imperative. While walking around Jurong, an industrial center, we saw huge banners everywhere urging workers to become computer literate. Free courses were offered at the Worker's Center, a kind of union.

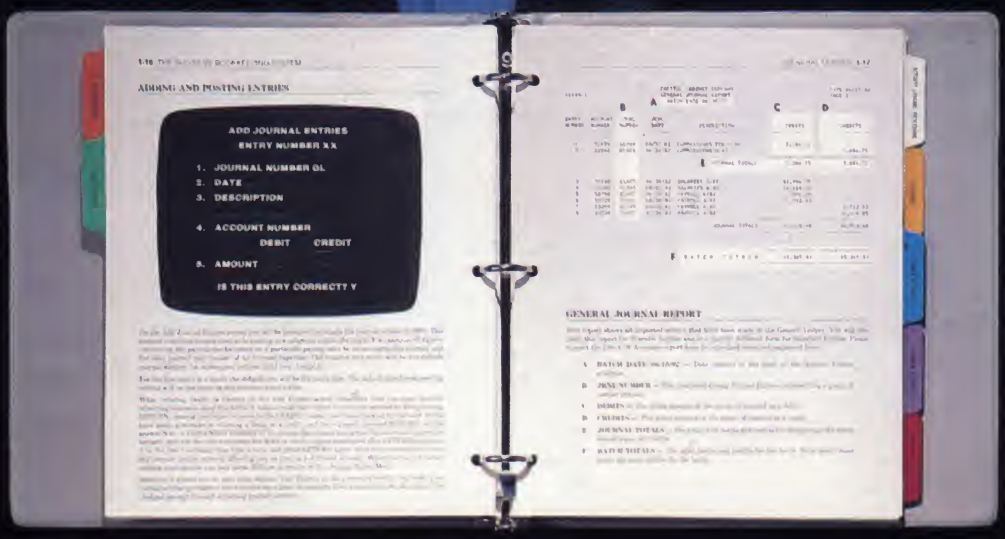
PINEAPPLES, ORANGES AND OTHER CHINESE COPIES

I spoke with several groups of personal computer enthusiasts in Singapore. At least three people allowed that they owned Apple look-alikes that cost considerably less than the genuine article. Two of these copies came from Hong Kong and one, apparently, from Taipei. (Apple has manufacturing facilities in Singapore but not in Hong Kong or Taiwan).

For the most part these Chinese copies look exactly like Apples (the shade of the case, keyboard markings and logos are slightly different) although some use entirely different housings and boards. Naturally, there is no warranty, and service is difficult to obtain.

On its part, Apple is trying to thwart these pirates. So far, Apple has won injunctions against five manufacturers in Hong Kong, one in Taipei, and one in New Zealand.

Apple has also enlisted the aid of U.S. Customs which is seizing fake Apple computers at major U.S. points of entry. This, of course, has no effect on sales in other major Apple markets such as Australia, Singapore, England, and Canada.



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ATARI, TOO, HIT BY CHINESE COPIES OF PAC MAN

Atari has taken legal action against two Hong Kong companies who were making Pac Man home video games.

Video Technology Ltd. and Soundic Electronics Ltd. received court injunctions to restrain the companies from manufacturing and marketing Pac Man games. Atari has exclusive rights to manufacture and sell the Pac Man home video game under a license from Namco Enterprises of Japan.

PRICING WAR: ROUND 3

Video game makers are beginning to feel the heat as the price of low-end personal computers comes close to that of video games. The $100 rebate on the TI 99/4A effective September 1 brings the effective price to $199. This is also the approximate street price of the Commodore VIC-20 after the new $25 to $40 wholesale price reduction.

Atari's reduction takes the form of six $10 coupons applicable to software packages, a clever way to get people buying the blades after the razor. And, of course, the Timex 1000/Sinclair ZX81 started out low--$99.

As a result of these declines, many video game makers are rethinking their prices. Rumor has it that the Atari VCS will drop to under $100 after Christmas; street price in the New York area now is $129. Mattel will probably lower the price of Intellivision to $149, down from $200 now. Magnavox, not waiting until January, has announced a $15 rebate on its Odyssey video game, although it's not much considering the $199 suggested list price.

COMPUTERS FOR ALL STUDENTS AT STEVENS, CARNEGIE-MELLON

Carnegie-Mellon University has one of the foremost programs in computer science today. Not only that, but most students at CMU in all disciplines except drama are expected to be computer literate and to use computers in conjunction with their courses.

To reinforce the view that computers are tools for use in all areas, every entering freshman at CMU will receive a powerful small computer. At the end of four years, the computer will belong to the student, its cost being built into tuition.

The computer the students will receive is no Apple. Expected to have nearly the power of a small DEC VAX system, the computer will also be able to tie into the university network of large mainframes. Just imagine 7000 students in one network playing spacewar. Target date for the start of the program is the 1983-84 school year.

However, Stevens Institute of Technology in Hoboken, NJ isn't waiting. Starting in 1982, every entering student in certain disciplines must purchase an Atari computer for about $750, a fraction of the $50,000 cost to attend Stevens for four years. Says Dean Edward Friedman, the objective is to have "the students begin to think of the computer as a permanent part of their intellectual support systems."

WHILE SOME TOWNS DEBATE VIDEO GAMES, OTHERS REAP THE PROFIT

Kent, Washington, a town of 23,000 south of Seattle added about $20,000 to the town coffers from nine video games it placed in a local recreation center.

Dallas also operates games in six recreation centers but turns them off during school hours. To discourage game addiction, players may not use a game for more than four consecutive plays.

And Fairfax County, Virginia has been operating games for four years. Projected revenue in 1983 is $110,000.

On the other hand, many cities such as Boston, San Francisco and Baltimore have rejected the idea of video games on public property. And even more towns have tough licensing laws, such as Morristown, NJ, for example that do not allow game arcades and only permit game installations in restaurants or stores where they are secondary to the main business.

SINCLAIR ZX81 OUT, TIMEX 1000 IN, SPECTRUM COMING

In accordance with their agreement with Timex, Sinclair is dismantling its North American mail order operations and granting exclusive marketing rights to Timex. This was to occur when monthly sales of the Timex 1000 (Sinclair ZX81) reached 75,000 units which they now have.

This also means that American Express will no longer sell the ZX81 from Sinclair (they sold 70,000 + units in four months) although they may well negotiate a similar deal with Timex, Commodore, Atari or TI. Am Ex admits to be "seriously talking with six firms."

An interesting conflict is brewing with respect to the Sinclair spectrum. Already a successful seller in Britain, Sinclair expects to start selling it in the U.S. in early 1983. However Timex claims its exclusive North American marketing rights also cover the Spectrum. Sinclair doesn't agree. Furthermore, Sinclair is talking to Am Ex about marketing the Spectrum. The 16K Spectrum is selling in the U.K. for a dollar equivalent price of about $200; a 48K unit goes for $280.

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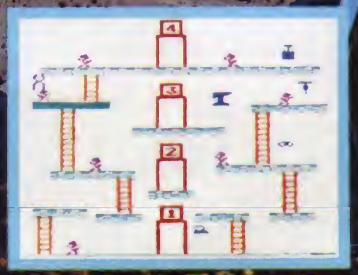

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Round 10: The Cannon.
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creative computing equipment evaluation

Terminal Velocity

John Anderson

Terminals. Those are for keypunch operators. They're the big, heavy, expensive things that cause eyestrain and tinges of green around the temples. Managers just don't deal with them, right? It would be demeaning. Or maybe that isn't really true anymore.

Wake up. That isn't true anymore. Managers who don't have them at their desks may be soon asked to clean out those desks entirely. Horrors! There is even a place for a terminal in the manager's home—if it is small, light, and inexpensive, of course.

Je Ne Sais Ma

In France, the national telephone company has embarked on an experiment. It is installing small, unimposing computer terminals next to the telephones in many homes. In the U.S., the phone company has attempted no such program. In contrast, the phone companies of a few states are attempting to levy staggering surcharges for the privilege of data communications over phone lines. This is a situation we'll be watching rather closely.

It is nevertheless possible, at modest expense, to attach your own small, unimposing terminal to the phone line, and, until Ma Bell finds an effective way to deter you, enjoy all the benefits thereof. In fact, the terminal we evaluated is a modified version of the terminal being distributed by the French. It is about 10" wide, 10" high, and 14" deep. That is remarkably small for the features it packs.

After having shown the Tymshare Scanset terminal to a few members of our staff, I got in the habit of holding a quick round of "The Price Is Right." "How much do you think it costs," I asked each victim, chuckling to myself. To the great credit of the Scanset, the whole crew overbid. Everyone was surprised at how much capability could be had for so little.

There are three models of the Scanset. The 410, for connection via RS-232-C to a computer or modem, can be had for $495. We received the 415, which has a built-in modem and modular jack for direct connection to the phone line. It lists for $649. Both models have an RS-449 connector for a serial printer. Another model will be introduced this fall. It will be similar to the 415, and include a telephone handset for under $1000.

The model 415 has some pretty special features. It stores and will automatically dial up to 36 numbers. If connection is established, automatic string transmission is available on four of the phone numbers. This means rekeying of access codes or sign-on protocols can be avoided.

In addition, up to 12 other strings of 36 characters can be stored for later transmission at a single keystroke. Internal batteries store your directories in 2K of CMOS RAM, so they will be preserved when the unit is off or unplugged.

There is a built-in speaker, which allows the user to hear the dial tone and dialing sequence, and to determine whether a connection has been established.

The 9" diagonal screen has 40- and 80-character modes, and is very sharp and easy to read. If no key is pressed for more than about five minutes, the screen will blank until one is pressed.

Six function keys across the top of the keyboard simplify the command configuration. Commands appear directly above the function keys at the bottom of the CRT. The far right function key is labeled "Next" from the connect mode, and pressing this key will bring up the next set of command functions. This makes learning and operation of the Scanset a veritable breeze.

For the time I had the terminal on my desk, nearly all visitors would stop and stare a while. "Wow!" or "Neat" or "That's cute" were the kinds of comments elicited. And justifiably so. The Tymshare Scanset is miniaturized extremely nicely.

The "Chiclet" style keyboard. Better for chewing gum than for touch typing.

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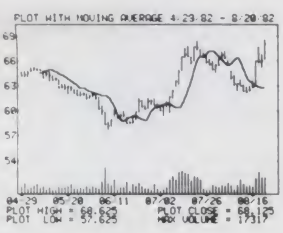

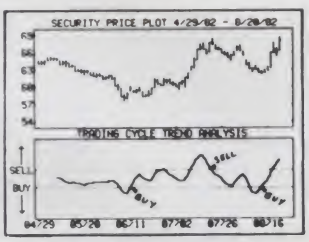

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Scanset, continued...

Not Even Ladyfingers

No product is perfect, and though the Scanset 415 comes close, it does have a few problems. The keyboard is what editor Staples has termed "Chiclet" style—more suited to a calculator keyboard. The keys themselves are placed very close together. After an hour or so on the Scanset your hands begin to feel like ham roasts. This may have been a necessary trade-off for the size, but I can envision a full-stroke keyboard that might have been fitted onto the unit without much sacrifice. Then again, I have never designed a terminal.

One thing that definitely troubled me was the proximity and placement of the shift lock and shift keys. The shift lock is of the same size and placed directly below the shift key.

As a result, you will often find yourself mistaking "shift-lock" for shift. And, as the shift lock is a "reversing" toggle rather than a true lock, it is less than utterly straightforward to recover from such an error once it has been made.

Perhaps sharp people with tiny fingers will disagree with my criticism concerning the Scanset keyboard. I admit, I can be slow and stubby-fingered at times. To such folk I would only underscore that I feel it is an excellent product, filling a gap in the small terminal market for the home or business.

Compared with the current alternatives, the advantage of the Scanset is clear. You can opt for a full-sized, full stroke terminal, but be prepared to pay for it, and then find a place for it. Add to this the cost and placement of a modem. And, even then the configuration is not likely to offer sophisticated auto-dial and function directories as are available with the Scanset.

At the other end of the spectrum, you might consider a hand-held terminal or pocket computer with terminal program. While these units have the advantage of great portability, they are also extremely limited. A 20-character liquid crystal display can't really compete with a CRT screen. And I'd take the Scanset keyboard in a second when compared to the keyboards on most hand-held machines. Typing on these for an extended period is an excruciating experience. More importantly, the cost of the hand-helds plus modem is not much lower than that of Scanset. Okay, you can't drag a Scanset into a phone booth. But anywhere there is an electrical outlet, it wins hands down.

I looked at a preliminary version of the manual that accompanies the unit, and found it quite straightforward and well laid out.

For more information, contact Tymshare, 20705 Valley Green Dr., Cupertino, CA 95014. □

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CIRCLE 161 ON READER SERVICE CARD

creative computing software evaluation

The Better Bulletin Board System

creative computing
SOFTWARE PROFILE

Name: Communitree, the first edition

Type: Conference host software

System: Apple II or II+, 48K
Disk drive (2 recommended)
Hayes Micromodem II

Format: Apple K-Sector diskette

Summary: Start of a new wave in human communication.

Price: $195

Manufacturer:
The Communitree Group
470 Castro St., Suite 207-3002
San Francisco, CA 94114

Michael Coffey

Every so often, we read an article about the great potential of microcomputers as videotext devices, community memories, or replacements for the Postal Service. We decided to plug in a modem and try a few of these possibilities. In particular, we wanted to explore the potential of computers to enhance human communication.

All over North America, computer hobbyists have put together systems that act as bulletin boards. With any terminal, you can call these systems and correspond with numerous hobbyists. Normally, you don't have to pay to use these systems. Of course, your phone company will charge you for the call.

Then there is the Communitree system and the computerized conference movement. While the bulletin board systems usually assume that all callers are members of the computer culture, the conference systems try to make the computer subservient to the user's other interests.

Hitting the Boards

Feeling community minded, we signed on to one Community Bulletin Board system after another. Although we enjoyed exchanging messages with fellow computerists, we noticed problems. Foremost among these were difficulties with the operation of the BBS software. We had to learn an entirely new set of commands, many of which were hard to remember.

Each command on a BBS is a one-letter abbreviation of a longer English word. Because they designed the system capriciously as they thought of tricks they wanted to do with it, the BBS programmers ran out of initial letters before they ran out of functions. The BBS user, therefore, must contend with some very contrived mnemonic devices.

The basic command is R to read a message. A normal person might assume that to do the opposite, write a message, the thing to type is W. Not so, baud rate breath, you have to type E to write a message. E stands for Enter, get it? In the noncomputer world, when was the last time you entered something other than an entrance?

We are being unfair, in a way, because the BBS was invented for hard-core computerist conversation. For this purpose, the system is fully adequate.

New Users Need New System

The many people who buy computers for the first time need a good way to use the communicability of their new pets. At minimum, they need a system that does everything a BBS does without any need for computer buzzwords during normal use. They should be able to read messages immediately and should be able to send substantial messages within an hour.

The Communitree system provides advantages for every kind of user. You can get by with only two or three commands. The system recognizes only seven commands in all. Each command is an English word and can be abbreviated to its first letter.

The three main commands are Read, Browse, and Index. To read a message, type "read" followed by the name of the message you want to read. The system displays the entire text of the specified message, along with a list of the daughters of that message. Since the entire system is organized as a family tree, you can read every message by starting at the root and reading all the daughters and daughters of daughters.

To get acquainted with a new tree, read the message called "conferences," which is the special name for the root of the whole tree. You will be presented with a list of messages that you can take as a list of topics being discussed on the tree.

The Browse command works like the Read command except that it only shows the first line of each message. The Index command shows no message text, it merely displays the names of all the descendants of the message you name.

In a marvelous fit of consistency, the Communitree designers endowed all three commands with the same set of options. Whether you want to Read, Browse or Index, you can limit the action by exercising the "starting," "find," and "com-

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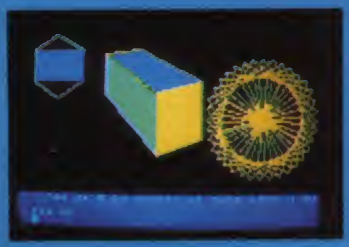

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Principal Software Authors: Stephen Maguire and Evan Rosen

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(Over 35 pages of documentation. Requires valFORTH.)

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A unique, two-part utility!

- Text Compression allows the packing of text into much less space than normally required. Useful for wordy Adventure games, "artificial intelligence," etc.!
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CIRCLE 306 ON READER SERVICE CARD

plete" options. Here are some examples of how the options work:

```
read FLOWER complete
```

would display the message called "flower" and all its descendants.

```
browse FLOWER starting 8-aug-82
```

would show all descendants of "flower" that are dated on or after August 8, 1982.

```
read FLOWER find daisy
```

displays messages tied to "flower" that contain the string "daisy"

Because these English-like commands are uncomfortably long for repeated typing, the system lets you abbreviate each option to a single letter. The longest example above becomes:

```
b FLOWER s 8-aug-82
```

The less frequently used options for Read, Browse, and Index are Beyond, Exiled, and Onlyexiled. Here are some examples:

```
r FLOWER beyond WATERING
```

displays descendants of "flower" that come after the message called "watering"

```
b FLOWER exiled
```

displays descendants of "flower" including those that are scheduled for deletion. Only by specifying "exiled" or "onlyexiled" can you look at moribund messages.

```
i FLOWER onlyexiled
```

shows names of only those messages belonging to "flower" that have been scheduled for deletion.

```
WELCOME TO THE CONFERENCE TREE

TERMINAL LINE LENGTH (20-80,
  OR CARRIAGE RETURN FOR 80)?40
LOWER CASE OK (C/R=YES)?

TYPE 'READ HELP' ANY TIME
OR 'READ CONFERENCES' TO START

'S' KEY TO PAUSE OR RESUME PRINTING

APEX NETWORK HARDWARE SOFTWARE TOPICS
OF INTEREST. APPLE/// USERS LINE

COMMAND?  R CONFERENCES

*** CONFERENCES              0-JAN-80
  PARENT= NONE                  USAGE=688
CURRENT CONFERENCES ON THIS CONFERENCE
TREE SYSTEM ARE:
     +++ SUBMESSAGES +++
 HELP                      16-JUL-81
 USERS                     16-JUL-81
 SYSTEM                    16-JUL-81
 INQUIRY-TREE               1-JUN-82
 PROBLEMS??                13-JUN-82
 HOURS                     13-JUN-82
 APPLE.II                  13-JUN-82
 FOLLK                     17-JUN-82
 DUMB.JOKE.BRANCH           9-JUL-82
 ASK.TECH                  12-JUL-82
 FOR.SALE                  12-JUL-82
 OS-9                      12-JUL-82
 CP/M                      13-JUL-82
 APPLE.///                 13-JUL-82
 FINANCIAL-SUPPORT         23-JUL-82
 BOOKS.&.THINGS             2-AUG-82
 MAKE-SUM-MONEY            19-AUG-82
```

Listing 1. Getting an overview of a tree. Conferences *is the name of the trunk of any tree. Each submessage has a set of submessages that you can read.*

Making Your Mark

We all enjoy reading databases. However, for many of us, contributing our own remarks provides even more excitement. We like the idea of having untold numbers reading our words, reacting to them and, perhaps, benefiting from the process.

To contribute to the tree, just decide which message needs your amendment, amplification, or answer. Then type "addto," followed by the name of the message you selected. Here is an example:

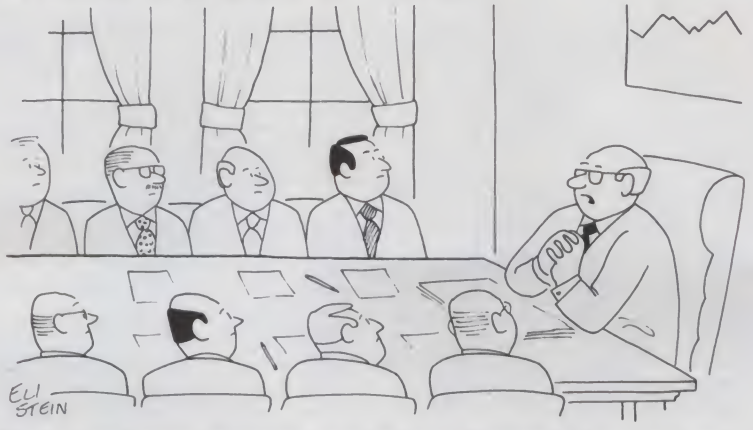
```
addto FLOWER
```

Now the system asks for the name of your new message. If you want to talk about a rose, type the name rose. The system will ask you to verify or change the current date and permit you to begin typing the text of your message. You may type as many as 50 lines of text. When finished, you press the return key one extra time.

The only problem comes when you make an error or change your mind about what you want to say. The system is not very good at helping you change things you have already typed. Changing something on the same line you are working on works all right, but changing a previous line requires typing that whole line over again.

The Communitree people would probably like to provide a full screen editor on their system, but such an editor would require a herculean programming effort if it were to work with all the different types of equipment that tie into the tree. For now, the old-fashioned backspace-and-retype line editor must suffice.

One very interesting fact about the Communitree system is that you need not sign your messages. Of course, you can stick your name, initials, or pseudonym in the last line if you like. Anonymity can encourage a degree of frankness that is not commonly found in face to face conversation.



"I want no interruptions, gentlemen—everyone please disconnect his pocket bleeper."

The Care and Feeding of Trees

The system stores the text of each message on disk along with some other information about it, including name and date. The system also keeps all message names and auxiliary information in RAM so that it can find things as quickly as possible.

A tree that grows unchecked will eventually fill a disk. You can add more disk drives, but the system can keep track of only 321 messages before it runs out of RAM. Naturally, you need a way to control the growth of the tree.

When messages become obsolete, boring, or offensive, you can remove them from the tree. This process is called

NOW, also available in Atari format!!!

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Software author Peter Folkos has created Alien Ambush, a space age nightmare. It's a hi-res, full-color arcade game, fiendishly written to give those nasty aliens every advantage.

So if you have access to a 48K Apple* with DOS 3.3 or a 16K Atari 400/800** with a disk drive, and you're hot for some new thrills, Alien Ambush was written for you. But be warned: it just got a lot tougher to survive in space.

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CIRCLE 231 ON READER SERVICE CARD

```
COMMAND?  R MJC

*** MJC                        15-AUG-82
  PARENT=USERS                   USAGE= 35
Michael Coffey, Technical Editor,
Creative Computing, 39 E Hanover Ave
Morris Plains, NJ 07950,  201-540-0445

       Technical specialties include
Apple II and III, CP/M, Pascal,
Fortran, WP, and database management.
Actually, I'm not very specialized
at all.  Nontechnical specialities
include communication, animation,
dance,
and roller skating.
          I would love to hear about
better software for conferencing
and about better computers that are
easier to use.

                                  Thanks for
being there ...
     +++ SUBMESSAGES +++
 HIYA!!!                  16-AUG-82
 VIC-20                   18-AUG-82
 HI-MIKE                  14-SEP-82

COMMAND?  A MJC

  DISK IS  36 PERCENT FULL
SYSTEM DATE IS      14-SEP-82
C/R IF OK, ELSE DD-MMM-YY:
YOUR MESSAGE NAME? DEMO-MESSAGE
ENTER MESSAGE.  EMPTY LINE (C/R ALONE)
TO LEAVE ENTRY MODE.
LINE  1:
-     THIS IS A DEMONSTRATION OF HOW
LINE  2:
-TO ENTER A MESSAGE ON THE CONFERENMCE
LINE  3:
-TREE.  NOTE THAT TYPOGRAPHICAL ERRORS
LINE  4:
-APPEAR IN THIS LISTING.
LINE  5:
-     THIS MESSAGE IS CALLED DEMO-MESSAGE
LINE  6:
-AND IT IS TIED TO THE MESSAGE CALLED MJC
LINE  7:
-

THE EDITOR COMMANDS ARE: LIST, REPLACE,
CONTINUE, QUIT, AND SAVEPERMANENT

EDITOR COMMAND? SAVEPERMANENT

WAIT A MOMENT...

COMMAND?  R DEMO-MESSAGE

*** DEMO-MESSAGE          14-SEP-82
  PARENT=MJC                  USAGE=  1
     THIS IS A DEMONSTRATION OF HOW
TO ENTER A MESSAGE ON THE CONFERENCE
TREE.  NOTE THAT TYPOGRAPHICAL ERRORS
APPEAR IN THIS LISTING.
     THIS MESSAGE IS CALLED
DEMO-MESSAGE
AND IT IS TIED TO THE MESSAGE CALLED
MJC
     +++ NO SUBMESSAGES +++
```

Listing 2. Adding a message. First, we read a message, then we add a new submessage. Our new message, Demo-Message, *is a branch of* MJC *which is a branch of* Users.

```
COMMAND?  I DUMB.JOKE.BRANCH

DUMB.JOKE.BRANCH
          9-JUL-82    84
 BAD-JOKE
          9-JUL-82    50
  MOUSE
         12-JUL-82    41
   MARIN
         16-JUL-82    31
 VITAMIN
         12-JUL-82    40
  HORMONE
          1-SEP-82    15
 RAPIST
         12-JUL-82    40
 DUCK
         12-JUL-82    39
 L2
         12-JUL-82    37
 L2.CORRECTED
         12-JUL-82    33
 WE'RE.FREINDS,RIGHT?
         12-JUL-82    30
 %CLONE-HEADS
         14-JUL-82    27
 ELEPHANT
         16-JUL-82    24
 BBZZZZZZZZZ...OUCH!
         16-JUL-82    24
 WILD,WILD-WESV
         19-JUL-82    31
 NEW-WAVE
         19-JUL-82    34
  WAVE-NEW
         27-JUL-82    26
   NOWIMREALLYCONFUSED
         27-JUL-82    27
 DAR.DE.DOOO!
         27-JUL-82    21
 SHOCKING
         29-JUL-82    22
 TENNIS.ANYONE?
         30-JUL-82    22
 BUNNY
         30-JUL-82    22
 THE*FAMILY*
         30-JUL-82    22
 NOW.SERIOUSLY,FOLKS
         30-JUL-82    20
 DIRTY-JOKE
         31-JUL-82    22
  AND.THEN
         28-AUG-82    11
 SURVEY-WARP
          2-AUG-82    22
 CHARGE!!!
          2-AUG-82    22
  DEW.DROPS
          2-AUG-82    20
 BUMPER-SNICKER-2
          3-AUG-82    18
 BUMPER-SNICKER-3
          3-AUG-82    16
 BUMPER-SNICKER-4
          3-AUG-82    17
 BUMPER-SNICKER-5
         12-AUG-82    20
 BUMPER-SNICKER-6
         16-AUG-82    16
 ALMOST...
         26-AUG-82    19
  THANK.YOU...
         26-AUG-82    16
```

Listing 3. Reviewing a branch. The Index *command displays the names, dates, and number of times used, of every message under a branch.*

pruning and consists of two steps. The first step is to *exile* the messages that should go away. Any user who knows the password can type "exile" followed by the message name to mark a message and all its offspring for later deletion. Only the system operator can complete the second step of the process, which is to *squeeze* the disks.

When a message has been exiled, it becomes harder to access but remains on the system, taking up space. When you squeeze the disks, the exiled messages and their offspring become overwritten by other messages, and previously used space becomes available. Since squeezing a disk can cause large bodies of data to disappear, the Communitree people

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CIRCLE 122 ON READER SERVICE CARD

recommend that you make a copy of the data disks before performing the squeeze. Once you have made a copy, you can squeeze without anxiety. If you do not like the results, you can recopy, move things around, and squeeze again.

Two important commands for moving messges around are "unexile" and "+addto." The first of these restores a previously exiled message to normal status. The latter command works the same as "addto" except that it starts with some text in memory, instead of starting from scratch. First you read a message you want to alter or move, then you type "+addto" and the name of the intended parent for the final message. Next, you give a new name to the message just read and alter it as if you had just typed in the whole text.

Here is an example in which we copy a message called "cherry-blossom" from a branch called "flower" into a branch called "fruit" and give it the new name "baby-cherry":

```
read CHERRY-BLOSSOM

+add to FRUIT

(computer asks for new message name)

BABY-CHERRY
```

At this stage, we have the ability to list the text of the message, add lines to it, delete lines, or save it as is. The old message will remain unchanged unless we go on to exile or otherwise modify it. With "+addto," we are merely creating a (possibly altered) copy of the original.

Summary and Evaluation

If you understand most of this article, you know almost enough to operate your own communitree. The only other requirement is the ability to plug in an Apple II, disk drive, and Hayes Micromodem II. If you understand only the first half of the article, you are almost fully equipped to use someone else's Communitree. You need to be able to turn on your terminal and dial your telephone.

To all observers at *Creative Computing*, the *Communitree* system showed distinct advantages over the generic bulletin board systems. Beginning users can appreciate the relative simplicity of the Communitree command structure. Heavy users enjoy the ability to read only those messages that are worth their time. Of the conference systems now available for 64K computers, *Communitree* is the best. We hope that many programmers will emulate the Communitree designers and their concern for appropriate design for the user and fulfillment of a carefully formulated goal. Their strong points are carefully orchestrated details, not frills. Their weak points are intelligent compromises, not cut corners. □

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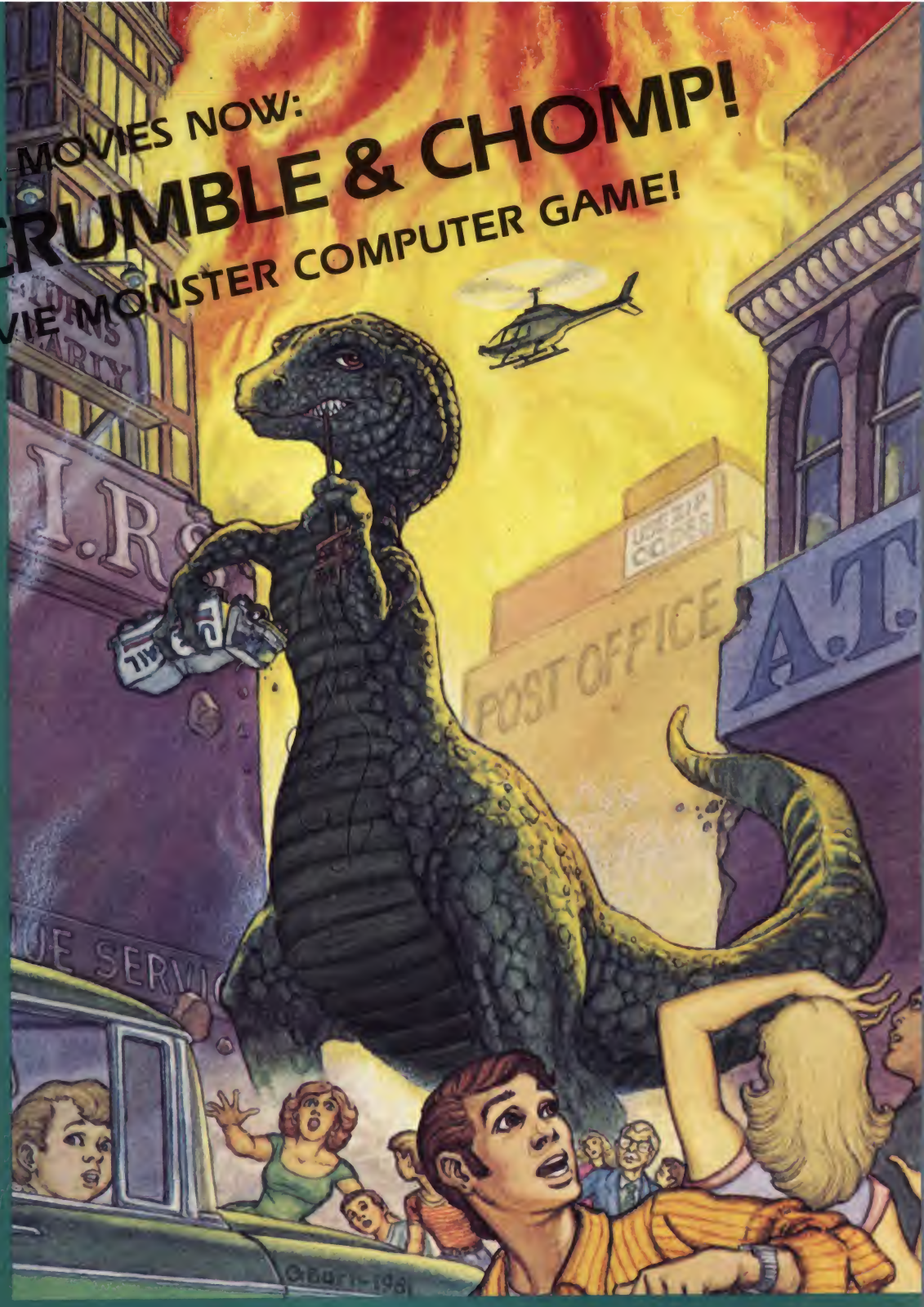

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New Processors For the Apple II

Michael Coffey

Long ago and far away, Steve Wozniak (the Woz) discovered a chip called the 6502. He decided to design a computer around it. For the past five years, countless engineers have been competing to improve that computer.

The most radical engineers have designed boards containing other processors to complement the 6502. The first such board to become popular was the Softcard, which contains a Z80 and is distributed by Microsoft Consumer Products. Since then, other Z80 boards and boards containing 6809s, 8088s, 68000s, and specialized math processors have been announced.

As a consumer, you may be wondering why you would want to add another processor to your Apple. The reason for most people is that these boards can deliver either increased performance or new features. Some can deliver both. In every case, you will have to learn new procedures to use a new board.

In this article, I shall describe boards containing the following processors: Motorola 6809, Intel 8088, Advanced Micro Devices 9511, and Motorola 68000. Each board comes with software and a manual. The prices range from $345 to $975.

The Mill by Stellation Two

When Stellation Two first announced The Mill, I was curious because the 6809 is supposed to be a big improvement over the 6502 in efficiency and programming. However, I knew that good software would have to be provided in order for the new chip to be worth buying. The Stellation people have earned my highest respect for assembling an impressive collection of software for their board.

The first Mill package was called the Pascal Speedup Kit. With the Mill and Stellation's enhancement to the Apple Pascal system, your Pascal programs can run up to twice as fast. When I tested the package, I found only slight improvements. However, fellow members of a Pascal user group have tested the package with its recent updates and found it to be quite helpful, especially with math-oriented programs.

The 88Card may be the card of choice for any business software developer who owns an Apple II.

Next, Stellation introduced a 6809 assembler that works with Apple DOS 3.3. The assembler is moderately powerful — on a par with the Apple DOS Toolkit assembler or Lisa. Not wanting to learn a new assembly language, I have not studied it in great detail. This assembler would be most useful to Apple owners who wish to develop software for other 6809-based computers, such as the TRS-80 Color Computer or the Hitachi MB6890.

Stellation's most important software product has been a package which includes OS-9 and Basic09 with the Mill for a price of $495. OS-9 is an operating system that contains many useful features borrowed from Unix, including multitasking and hierarchical file directories.

Basic09 is an elegant hybrid of Basic and Pascal. Both the language and the operating system were published by Microware Systems Corporation and adapted to the Apple II by Stellation Two.

88Card by Coprocessors, Inc.

CP/M is an operating system used by hundreds of thousands of computers. CP/M-86 is a new version of CP/M designed for Intel's new microprocessors, including the 8088. Coprocessors supplies an 8088 card with 64K of RAM along with a disk containing CP/M-86, all for $899.

Since CP/M-86 can be used on the DEC Rainbow 100, the IBM PC, and most other new business computers, the 88Card may be the card of choice for any business software developer who owns an Apple II. Of course, several other vendors are planning products very similar to the 88Card. As we go to press, Coprocessors is the only company that has managed to ship a working CP/M-86 system to *Creative Computing*.

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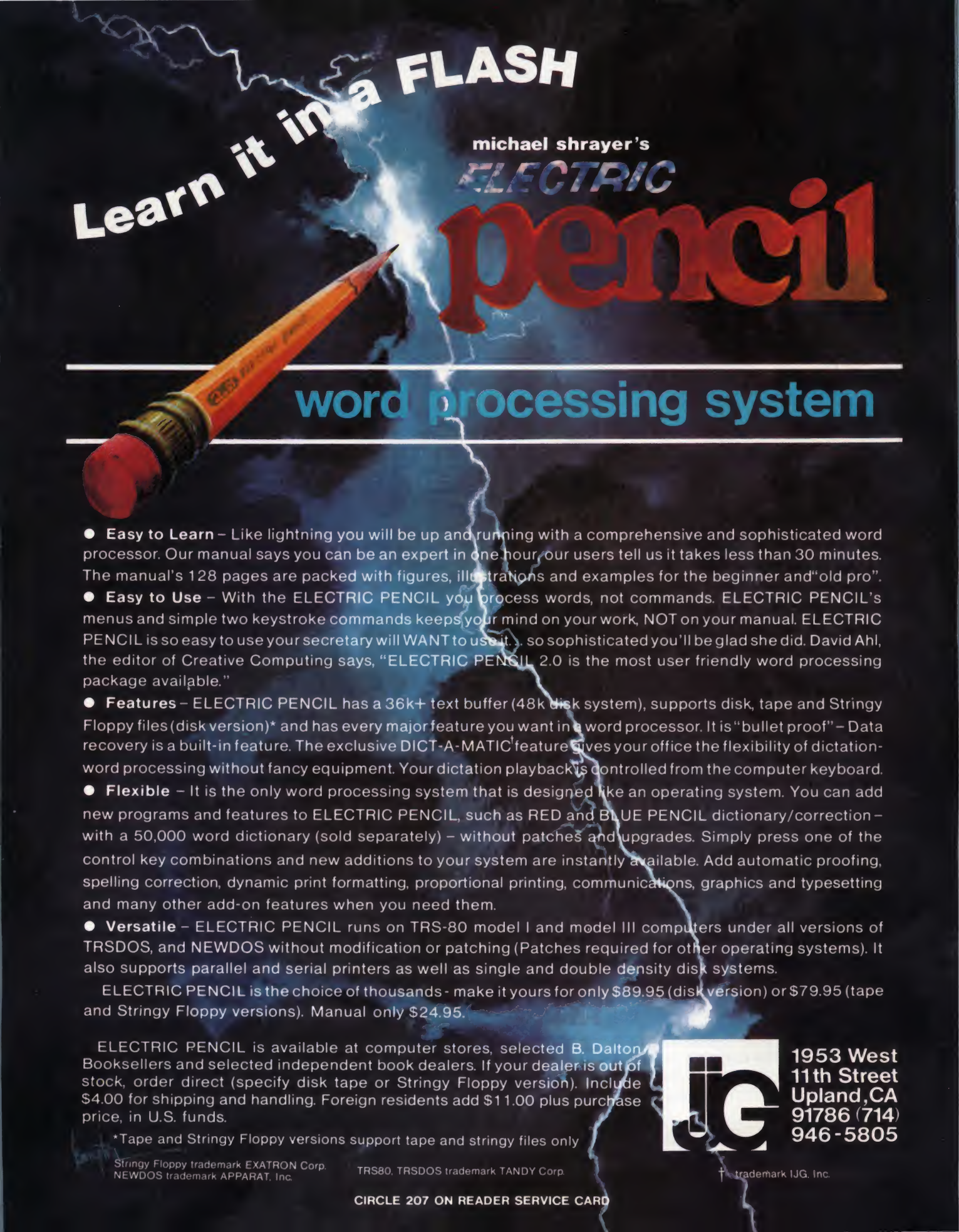

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Basic09, The Elegant Hybrid

As a language cynic, I was prepared to ridicule Basic09 as yet another nonstandard implementation of the ancient and honorable beginners all-purpose symbolic instruction code. I was stunned to discover that Basic09 combines the friendliness of Basic and the logical structure of Pascal without imposing too many nasty inconsistencies. If I were to build my own algebraic programming language, I would make it look very much like Basic09.

Important legacies from Pascal include named procedures, structured data types, and advanced loop statements. Programs need not contain line numbers. Procedures can call themselves, and all variables are local to the procedure invocation in which they are used.

Unlike Pascal, Basic09 will not let you nest procedures within procedures. This rule disallows multiple procedures with identical names and forces all shared data to be passed as parameters. Named constants and explicit pointers are also missing from Basic09. The lack of pointers makes some programs difficult to translate from Pascal.

With Basic09, you get most of the familiar Basic features. Input statements can prompt the user, and strings are fully implemented, as in Applesoft or Microsoft Basic. File input and output are fully integrated into the language, not pasted on as in Applesoft. The Read... Data...Restore suite, missing from most Pascals, and only partially implemented in Applesoft, is fully functional in Basic09.

I used the Basic09 editor/compiler to enter several programs. The system caught many syntax errors as soon as I typed them. Others were caught when I crossed from the Edit mode to the System mode. I enjoyed having a chance to fix errors before running my programs.

Basic09 flips into Debug mode whenever it encounters an error or user interruption during a program run. This handy mode allows you to display values of variables and other indicators of program status. You can also wade through the program, statement by statement. When I first learned to program, I had to simulate that function by hand on paper and pencil. Although I wish the debugging commands were integrated into the System mode, I am satisfied with the provided set of features.

You can learn the program line editor in just a few minutes. Unfortunately, the main reason for this ease of mastery is the lack of powerful editing features. You will never mistake this editor for a word processor because you can not easily change existing lines. You must issue a Change command, retyping the old version of the text piece you want to change followed by the new version.

Basic09 incorporates many important advantages for serious programmers. All operating system facilities, including multitasking and file maintenance, are available within all Basic09 modes and user programs. For example, your Basic09 program could read a disk directory and display a list of file names before asking the user to choose a file to read.

Programmers will find I/O implemented more sensibly in Basic09 than in most other systems. You use all sequential files (e.g., most disk files) the same way you use all sequential I/O devices (e.g., keyboards, printers). Consequently, you can write programs without regard to the origin or destination of data, leaving the decision to the user. The file system makes no distinction between direct-access and sequential disk files. Therefore, you can write files using one technique and read them using the other.

The I/O statements are quite well designed, especially when compared to Applesoft. You can keep many files open at the same time and never get bogged down with channel numbers or other rigamarole. Ordinary Basic Input and Print commands can be used with any file. The Read and Write commands are similar to Input and Print, but are specialized for use with files, making it easy to put multiple values on each line of a file.

For random access to records, you use the Seek command which skips to the specified byte of a file. Get and Put perform high-speed data transfers between variables and files, performing no interpretation or conversion of binary data representations.

The Create command initializes disk files. The Open command associates operating system file names with Basic variables for use in subsequent I/O statements. The Close statement terminates access to a file, frees the memory associated with it, and (in the case of disk files) forces data to be recorded permanently. Finally, you can use Delete to get rid of files you don't need.

The Basic09 package is a very worthwhile system, especially for computer science students and companies with programming staffs.

I booted the Coprocessors system, and found it works much like every other CP/M system I have used. My biggest problem was that I had no CP/M-86 applications to run. CP/M-86 has only a few enhancements over regular CP/M (now called CP/M-80). The best of these, from the user point of view, is a Help command.

Other new commands in CP/M-86 include TOD and COPYDISK. TOD can set or read the time of day, and COPYDISK duplicates a CP/M-86 disk. In CP/M-80, these functions are performed by third-party programs.

CP/M-86 offers many benefits to the assembly language programmer. The ability to manage large chunks of memory and the ability to move programs up to MP/M-86 (the multiuser system) and Concurrent CP/M-86 are foremost among them.

The 88Card implementation of CP/M-86 contains a few surprises. The system disk, for example, contains no disk formatting program. I had to use the Apple DOS INIT command. The COPYDISK command works only with two disk drives, and the entire system is designed with an 80-column display in mind. Rumor has it that newer versions of the software will include a formatting program.

The general unfriendliness of CP/M has not prevented it from becoming a standard for business software developers. Many programming languages are already available for CP/M-86, and virtually every major 8080 and Z80 software developer is now polishing 8086 software for marketing as soon as possible. Why not jump on the bandwagon?

In the 8088 arena, CP/M-86 has one major competitor. IBM supplies an 8088 disk operating system called PC-DOS. That operating system is

owned by Microsoft who sell it under the name MS-DOS. The differences between the current versions of MS-DOS and CP/M-86 are quite subtle. Both systems are direct derivatives of regular CP/M. I expect that MS-DOS will soon be released for the 88Card. Many software developers have told me that they intend to support both systems. Therefore, you needn't worry about buying the "wrong" operating system.

AD8088 by ALF

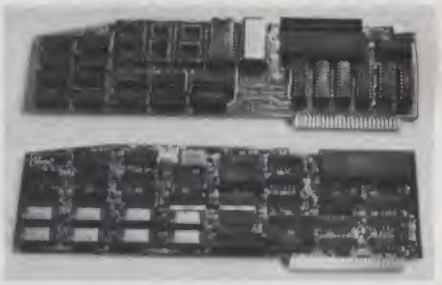
Intel, one of Silicon Valley's giants, has designed the 8088 chip to replace the 8080 as an industry standard. Companies as diverse as IBM, Microsoft, and Digital Research have decided to support this new Intel product, and no fewer than four companies have announced 8088 boards for the Apple II. One of the great frustrations of the past year has been the lag between announcement and delivery of some of these boards.

The AD8088, as hinted above, is the first in a series of ALF boards that will work together to soup up your Apple.

ALF Products, best known for their wonderful line of music products for the Apple, have turned their Apple expertise toward a new set of performance enhancing boards, the first of which contains an 8088, some ROM, and just a little bit of RAM (2K), all for just $345.

The ALF AD8088 card comes with software that makes Applesoft run faster. The system requires a 16K RAM card in slot 0. When you have installed the ALF system, nearly every Basic program in your library will run faster. Even compiled programs and some machine language programs will experience performance improvements.

ALF always provides excellent documentation with their products. The AD8088 was easy to install and use. I just plugged in the card, typed RUN FTL and the slot number of the card. From that point until DOS was rebooted (or the computer turned off), the 8088 helped Applesoft run faster.



Two 8088 cards. On top is ALF's AD8088, which supports Applesoft and can hold 12K RAM. Below is Coprocessor's 88 card, which supports CP/M-86 and contains 64K RAM.

I tried the system with a function plotting program. The program computes many sines and cosines and plots hundreds of points. I ran the program with and without the AD8088. I also compiled the program using Speedstar and ran the compiled version with and without the AD8088. The results are shown in Table 1.

Table 1.

	Without AD8088	With AD8088
Basic	34 seconds	15 seconds
Compiled	26 seconds	7 seconds

As you can see, the card outperformed the compiler when used separately. The combined performance of the compiler and the ALF system is astounding. Performance improvements will vary with the type of program. I was able to concoct some programs which showed no improvement at all, by either method.

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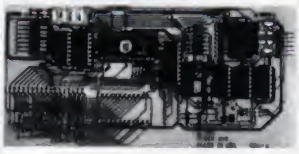

The original Keyboard & Display Enhancer is still available for Revision 0-6 Apples [on which the new Enhancer][will not fit]. These Apples have memory select sockets at chip locations D1, E1 & F1. The Keyboard & Display Enhancer allows entry and display of upper and lower case letters with fully functional shift keys. It does NOT have user definable keys nor a type ahead buffer.

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To accomplish speed improvements, ALF altered the Applesoft interpreter to force the 8088 to do most of the arithmetic. The more arithmetic you have in your program, the more you will benefit from this card. Most graphics programs contain lots of multiplication and division, two things that the 6502 does very slowly.

You can write 6502 assembly language programs that use the 8088 for arthmetic or block movement. You can also write 8088 programs, though no assembler is provided. The 8088 programs can run simultaneously with 6502 programs. In the future, standard operating systems, like CP/M and MS-DOS should become available for the AD8088.

The AD8088, as hinted above, is the first in a series of ALF boards that will work together to soup up your Apple. The next board will contain up to 128K of RAM, and the third will contain a special graphics processor. The graphics card, priced at $145, should speed up Applesoft graphics commands and provide new graphics facilities. The RAM card will cost $445 with 128K, $370 with 64K, or $295 with no RAM. The card will also accept an Intel 8087 numeric processor which ALF plans to sell for $195. Rumored delivery dates are well before Christmas.

The Fast Floating Point Board by Computer Station

The FFP holds seniority over all the other boards in this review. Computer Station, makers of fine graphic printer drivers and other software, has been selling the product for as long as I can remember. The AMD 9511 does exactly one thing, arithmetic. The advantage of this specialization is that the chip operates very fast, performing thousands of floating point operations per second.

Computer Station provides effective software and simple documentation for interfacing this processing power to Applesoft, Pascal, and Fortran. The whole package costs $475. Among the boards reviewed here, only the FFP board and the Mill include software for Apple Pascal. Like the other processors, the FFP requires a RAM card when used with Applesoft.

Installation creates no hassles. Plug in the card, boot the system, and rename a couple of files. The system works in any slot except zero. When you boot the Apple, a modified Basic interpreter is loaded, so until you reboot, most Basic programs should run faster. After this installation, the configured software can be copied to other disks from which it will automatically install itself.

I tried the FFP with the same programs I used with the AD8088 card. The performance was very similar to the AD8088 for the program containing trignometry and graphics.

Table 2.

	Fplot	Primes	1000 square roots
6502	34	53	51
AD8088	15	23	10
9511	15	29	5

However, a prime number program was not quite as fast on the FFP as on the AD8088. On the other hand, a program that calculated 1000 square roots ran much better on the FFP. The timings (in seconds) are summarized in Table 2.

The story behind these results is interesting. The 9511 performs floating point operations faster than the 8088 because there are no built-in floating point instructions on the 8088. To use the 9511 in conjunction with the 6502, however, a numeric conversion must be performed. Dave Hudson of Computer Station found that, in some cases, the numeric conversion takes longer than the time saved by the 9511. His software uses the 9511 only for the most time-consuming functions, not for multiplying and dividing. The ALF software uses the 8088 for all multiplications and divisions as well as the more time-consuming operations.

One big advantage of the FFP is Pascal-Fortran compatibility.

The only big disappointment I found with the FFP came when I used it in conjunction with compilers. Although some programs worked, others did not. I tried both Speedstar and the Hayden compiler, getting similar results from each. The function plotting program is among those which do not run on the FFP when compiled. A smaller complaint is that arithmetic performed by the 9511 is slightly less accurate (6-digit vs. 9-digit) than that done by the 6502 or 8088.

One big advantage of the FFP is Pascal-Fortran compatibility. After installing the Computer Station software unit into your system library, you can use the 9511 for all transcendental functions. The faster sines and cosines of the 9511 should help many graphics and engineering programs.

Coming Soon: A Specialized Processor for Graphics

ALF Products has announced the ADGS graphics subsystem to be used with their AD8088 card for the Apple II. The standard Applesoft HGR, HPLOT, DRAW, and XDRAW functions will operate faster than ever. New capabilities, including additional colors, block drawing, window clipping, and exclusive—or plotting, will be implemented.

Many of the features of today's graphics utility programs have been designed into the hardware of this new card. Color character fonts, 3-D line drawings, color fill, and hi-res scrolling are among the techniques that will now be fast enough to be practical. Furthermore, since these capabilities are implemented on a card, your programming will be much easier than with disk-based utilities.

The ADGS will also have connectors for eight paddles or four joysticks. The analog interface provided will read devices three times faster than the Apple game paddle port does. This means that your programs can respond more accurately to paddle or joystick input when using the ADGS.

The ADGS uses direct memory access techniques to perform these functions without assistance from the Apple 6502. The AD8088 card contains ROM software that controls the ADGS. The speed of the AD8088 in calcualting and moving memory is one of the secrets to the great speed of the ADGS. The combined price of the ADGS and the AD8088 is $490, which includes all necessary software and documentation.

Although I have not tested the ADGS, I think you should know about it before purchasing a new processor card. The ALF reputation for reliable, easy to use products suggests that the ADGS will be a good product to try.

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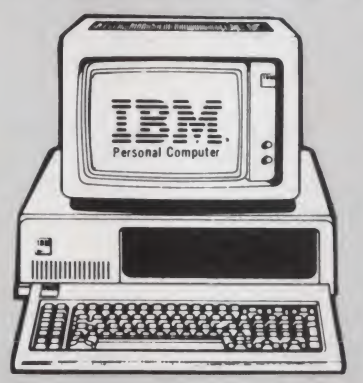

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CIRCLE 147 ON READER SERVICE CARD

Dtack Grounded 68000 Board by Digital Acoustics

The revenge of Motorola comes in the form of the most powerful single-chip CPU available today. The folks at the microprocessor division were sickened by the enormous success of MOS Technology's 6502, which was invented by ex-employees of Motorola. The 68000, with a 16-bit data bus, 24-bit address bus, and many 32-bit registers, is in many ways more powerful than most of the computers made by DEC and Data General. This microprocessor can address 16 megabytes of memory, without bank switching, segment selecting, or other software bookkeeping.

The Dtack Grounded board does not fit inside the Apple II. Instead, it must lie outside your computer, connected to it via a ribbon cable and small interface card, both of which are supplied. Also in the package you will find a disk and several documents. The disk contains an Applesoft interface and an impressive 3-D graphics demonstration. The price for all this varies according to how much RAM you want on the board. The 12K version costs $627, and the maximum RAM board, 92K, goes for $947.

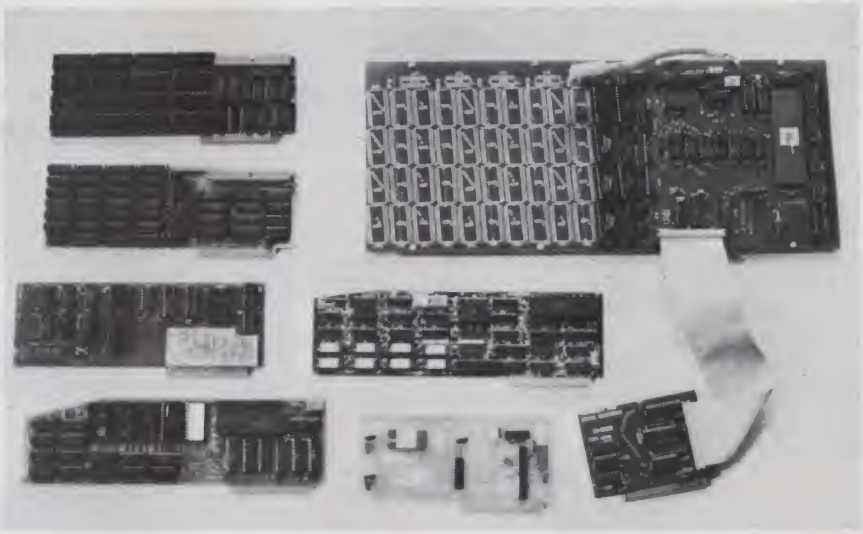
The software for Applesoft speedup is not quite as simple to use as that provided by ALF and Computer Station for their boards. Besides booting a modified DOS, you must add a two-statement prefix to each Basic program. That prefix loads and activates a link to the Dtack board. I found no other problems with the system.

Theoretically, the Dtack board should be much faster than the 8088s, 9511 or the 6502. Timing (in seconds) for the Fplot program is shown in Table 3.

Table 3.

	Without 68000	With 68000
Basic	34	13
Compiled	26	5

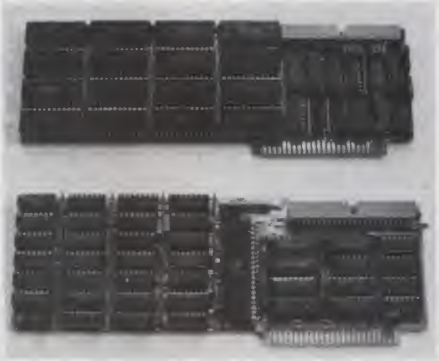
You can see only a modest advantage for the 68000 compared to the AD8088. Assembly language programmers should be able to squeeze out greater benefits. The supplied software makes the 68000 perform only the arithmetic parts of each program. By recoding graphics and other parts into 68000 assembler, you can achieve more dramatic results. The Dtack demonstration software shows detailed 3-D images being generated in motion in real time. All observers were impressed. However, nobody volunteered to duplicate the feat.



Processors on Parade. The magnificent specimen in the upper right is the Dtack Grounded 65000 board, which is approximately the same size as the Apple II motherboard. Attached to the Dtack is the interface card that ties it to the Apple bus. Proceeding clockwise, we see the FFP from Computer Station, the AD8088 from ALF, the Mill from Stellation Two, the Booster CPU, and the Booster 32K RAM card, both from Number Nine. Smack in the middle, we find the 88 card from Coprocessors.

The Booster System by Number Nine Computer Engineering

Last but not least in our survey comes a board that does not have a revolutionary new processor. Instead, it has a souped up 6502. The CPU in this system is the 6502C, which can run much faster than the CPU in the Apple and run *All* the same software. To take advantage of the faster CPU, you must also buy a special RAM board from Number Nine. A very fast 32K static RAM board costs $625; the processor board sells for $350.



The Booster System includes a 32K RAM card (top) a 3.6 MHz CPU (below) and a 128K RAM card (not shown).

The booster boasts the easiest software installation of all the boards tested. Absolutely no alteration to software is required. Consequently, all games, languages, and applications, even copy-protected programs like Visicalc, can take advantage of the high-performance hardware.

The hardware part of the installation is not so easy. The CPU and RAM boards communicate with each other via a ribbon cable. Because these boards can provide many functions beyond merely speeding up an Apple, there are many jumper switches on them. Figuring out how to set the jumpers can be difficult.

The manuals that come with the boards contain straight reference material suitable for engineers. Most ordinary people buying these boards will have to go through some trial and error, and may have to call the manufacturer for advice.

Number Nine also makes a 128K dynamic memory board which, theoretically, could make performance a teeny bit faster when used in addition to the 32K board and CPU. Using the 128K board without the 32K board should work out a bit slower. The bigger board costs $625. I tested a system with 32K of Booster memory, since it seemed to be the most cost-effective configuration.

My timing tests showed that this is the fastest CPU when running interpreted Applesoft Basic. It also acquitted itself very well with the compiled FPLOT and prime number programs. The timings (in seconds) are shown in Table 4.

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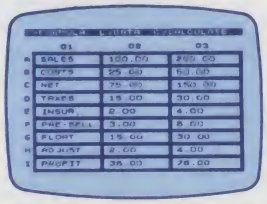
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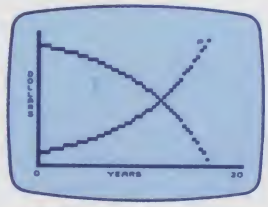

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CIRCLE 204 ON READER SERVICE CARD

68000, as implemented on the above boards, might complement each other, I tried both of them together. Not surprisingly, the combination yielded the best times of all. With this combination, programs ran from 5.7 to 23.3 times faster than they did on the plain 6502, at a total added cost of $1602. The timings (in seconds) can be found in Table 5.

Table 4.

	Without Booster	With Booster
Basic	34	10
Compiled	26	8

Table 5.

	Standard 6502	With Booster and 68000
Basic	34	6
Compiled	26	4

Performance Comparison

Table 6 contains a summary of all of the tests I performed. The only blemish results from the fact that Fplot would not run with the 9511 after compiling. The "Combo" line shows the results of using the 6502C together with the 68000.

The only clear winner is the 6502C/68000 combination. The 6502C excelled mainly when running interpreted Basic. The 68000 impresses most at running compiled programs. Don't forget that the 6502C can speed up programs in any Apple compatible language; the other boards are more limited.

The 8088 and 9511 ran neck-and-neck in these tests, but the 8088 seems to have an advantage since it is a more general processor. The ALF 8088 card also calculates numbers with greater accuracy than the 9511 (9-digit vs. 6-digit precision.) You can expect additional language and operating system support for the AD8088.

The compiled programs were produced with the Speedstar compiler from Southwestern Data Systems. The Primes program calculates and prints all the prime numbers between 0 and 1000. The Fplot program calculates many sines and cosines and plots hundreds of points. The roots program calculates 1000 square roots and prints status messages as it runs. These tests indicate not the full potential of the cards, but the power available to an ordinary Basic programmer.

Summary

Each of the products completely fulfilled the promises made for it. I have described six different cards for three different kinds of users. The ALF, Computer Station, Number Nine, and Dtack Grounded cards give improved performance to most existing Applesoft applications. The Stellation card provides an exciting new programming environment. The Coprocessors card prepares you for a new generation of business applications.

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Santa Ana, CA 92705

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Table 6.

	Interpreted			Compiled		
	Primes	Fplot	Roots	Primes	Fplot	Roots
6502	53	34	51	43	26	49
9511	29	15	5	24	**	9
8088	23	15	10	15	7	8
6502C	15	10	15	12	8	14
68000	20	13	5	12	5	3
Combo	8	6	2.8	6	4	2.1

Table 7.

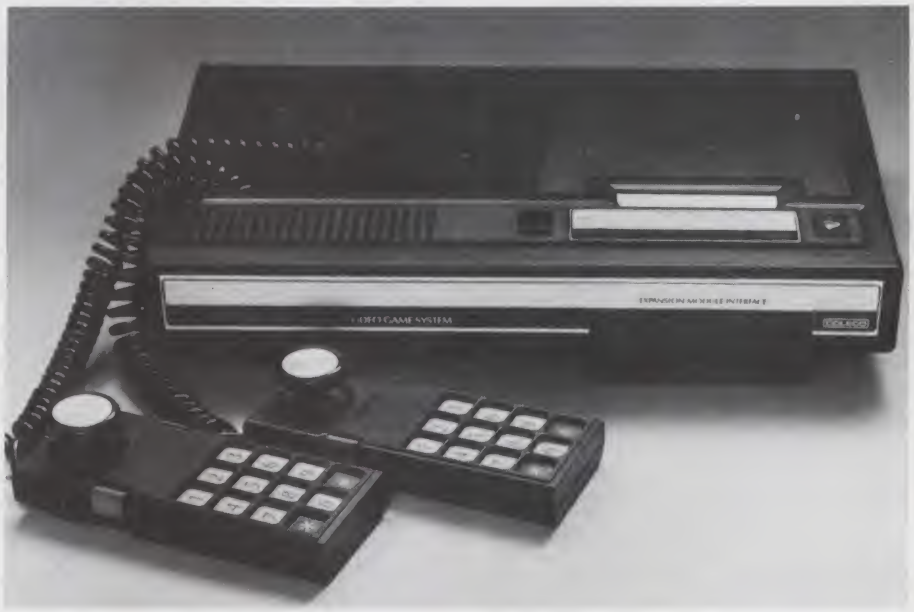
Manufacturer	Model	Processor	Emphasis	Price	Pascal/ Fortran?
ALF	AD8088	8088	Performance	345	No
Computer Station	FFP	9511	Performance	495	Yes
Coprocessors	88Card	8088	Features	899	*
Dtack Grounded	68000 w/12K	68000	Performance	643	**
Number Nine Engineering	Booster CPU+ 32K RAM	6502C	Performance	975	Yes
Stellation Two	OS/9 Mill	6809	Features	495	Option

*CP/M-86 can support many languages from various vendors, but not Apple Pascal.

**Pascal support for the Dtack board is available from other suppliers.

New Kid On The Block

Owen Linzmayer



Ever since its introduction five years ago, the Atari Video Computer System (VCS) has been the most popular home arcade game machine. Several manufacturers have tried to topple Atari from the top of the ladder. To date, none has succeeded. Most of these companies lacked one or more of the following: a better product, a large advertising campaign, a well known brand name, or continued product support. Enter Colecovision.

Colecovision is the newest and most promising contender for the home arcade game crown. Not only does Colecovision have respectable origins, it is backed by a tremendous radio and television advertising campaign. In my opinion, Colecovision is a much better product than the Atari VCS, and if the cartridges currently available are any indication, Coleco seems to have devoted considerable thought to user support.

The System

The basic Colecovision package has no manufacturer suggested retail price. Prices in the stores range from as low as $160 to upward of $200. The basic system consists of a console unit, two hand-held controllers, a power supply, a complimentary *Donkey Kong* game cartridge, an antenna switch box, and a video cable. Everything you need to play, except a working color television set, is included in the Colecovision package.

The Console Unit

The main console unit is composed of sturdy black plastic with a grainy finish. It has a low-profile, sleek design and measures only 15" x 9.5" x 5" with a game cartridge inserted.

The sliding on/off switch is clearly marked and located to the left of the cartridge slot. Although the words ON and OFF are printed directly to the side of it, due to the nature of a sliding switch, it is not very clear whether the unit is on or off. For some reason, Coleco, like most other home game manufacturers, neglected to include a small LED on/off indicator. This would have been useful, particularly for young players.

Directly to the right of the power switch is the RESET button. This button is flush with the surface of the console, making it difficult to hit accidentally. Pressing the RESET button at any time causes the unit to end the current game, and returns you to the banner screen. Incidentally, every time the system is reset or powered-up, you must wait for 12 seconds before you can choose a new difficulty level and begin again. This is one of the most annoying waits I have ever encountered in a game.

Located on the righthand side on the front of the console is the interface port. Three expansion modules that can be plugged into this port—one at a time—have been announced. Covering this opening is a flimsy little door that slides up to allow access to the exposed edge connector.

At the time of the initial release of Colecovision, there were no expansion modules available. I spoke with Coleco representatives who said that there should be two expansion modules on the market by the time you read this. The first module, with an estimated retail price of $60, will allow any cartridge that runs on the Atari VCS system to be run on the Colecovision. In other words, owners of Atari VCS systems can buy new Colecovisions and continue to use their old cartridges—a very clever marketing ploy.

The second expansion module is a driving controller. It consists of a large steering wheel, a numeric keypad, and a pressure-activated footpad that acts as the accelerator. The only cartridge currently available that makes use of this module is *Turbo*. Arcade fanatics know Turbo as *the* racing game from Sega/Gremlin. Coleco has plans for other flying and driving games that will make use of this module.

Coleco also has plans for a keyboard module which will turn the ColecoVision game unit into a computer. A release date for this unit has not been announced.

When properly inserted in its slot, the cartridge protrudes about 2" from the console. The game cartridges and the slot are designed to make it impossible to insert a cartridge incorrectly. The advan-

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tages of this design are, however, diminished by the fact that you can still plug a cartridge in while the power is on. If you do plug a cartridge in while the power is flowing, you may destroy the cartridge. There should be a safeguard to prevent such accidents.

On the back of the cabinet, there is a switch which allows you to select TV channel 3 or 4 for game play. This switch is recessed and is hard to get at even with a pencil tip, making it difficult to change—either by design or mistake. Right next to this switch is the video-out RCA connector. To the left of the RCA connector is the power connector. The removable power cable has four prongs arranged so that it can't be plugged in incorrectly—another example of good design.

The right half of the console contains the "guts" of the system. Most of this space is taken up by the main logic board. The left half of the cabinet is a recessed storage area for the hand-held controllers. On the bottom of the storage well is a drawing of the controllers, which indicates which controller is to be used by each player.

Hand Controllers

It always amazes me when I, with excellent hind-sight, notice something *so* wrong that I wonder if the manufacturer had anyone test the product. I feel that way about the hand controllers for the Colecovision, each of which consists of a joystick, two fire buttons, and a keypad. These controllers get high marks for comfortable use, but fall short when it comes to responsiveness.

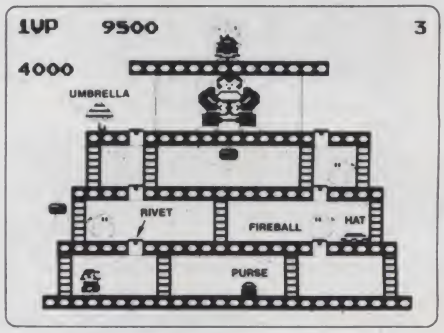
The eight-directional joystick is not really a *stick* at all; it is more like a joy*knob*. At first, I thought that since the knob spun, possibly it doubled as a paddle controller. Not so. Although a joystick and paddle on the same controller is a good idea, it just wasn't meant to be. After an initial break-in period, the joystick does become more responsive and accurate. Even so, I would prefer a real stick that I could grab hold of rather than a small knob. Based on the press releases for it, it appears that the new Atari 5200 video game system has controllers similar to those of the ColecoVision, but with a real joystick.

The two fire buttons on the controller are located directly opposite one another. These buttons are totally independent, which means they can control two different actions. The left button is perfectly positioned for a teen-age hand, but the right one should be just a tad lower for maximum comfort.

The keypad on the controller is used primarily for selecting difficulty levels. The keypad arrangement is similar to that found on a touch-tone telephone. Rather than buttons, there are twelve small, plastic-encased switches on a thin board. Unlike many computer systems that use similar membrane keypads, these switches provide a satisfying click when pressed. There is a slot on the controller that allows a keypad overlay to slide in from the side.

From all obvious signs, the controller is meant to be held in the left hand, with the right hand manipulating the keys and the joystick. One nice thing that proves the designers really *do* care about you, is the small, smooth recess on the controller where your pinkie grips the side. They must have wanted to build a more comfortable controller than those used on other game systems.

The controllers themselves can be detached from the console. Each has a curly cord that, when stretched to limits, measures 5'6". This cord is similar to the



Screen 2 of Donkey Kong.

cord found on the handsets of most telephones. The ColecoVision designers again tried to make it impossible for you to make a mistake. The plug can be inserted only one way—with the side marked TOP facing up.

If you don't like these controllers, don't worry. Any controller that works with an Atari VCS or home computer also works with the ColecoVision. When a ColecoVision is plugged into an Atari, only the joystick and left button are functional. If you are using an Atari joystick, you must still have one ColecoVision controller plugged in so that you can select difficulty levels with the keypad, and you must limit yourself to games which use only the left button, as this is the one that corresponds to the Atari fire button.

Power Supply

The ColecoVision unit plugs into a 110/120 VAC outlet. The 5'8" power cord that emerges from the back of the console has a bulky 4.5" x 3" x 2" black plastic power supply at the other end. The purpose of this power supply is to convert the AC into low-voltage DC.

The owner's manual instructs you to remove the power supply when you are not playing, but it is an easy thing to

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forget. If left plugged in for an extended period, the power supply gets rather hot, but probably not hot enough to set your house on fire.

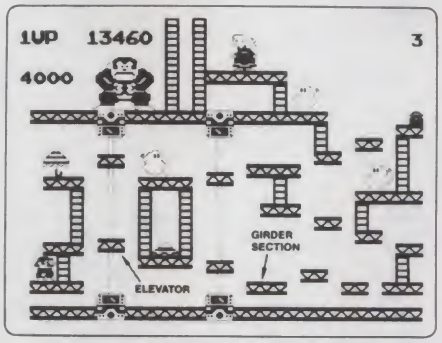
Switch Box and Video Cable

For your convenience, ColecoVision comes with a small box that allows you to switch your TV from normal to game mode. With this box attached to the VHF terminals of the TV and the antenna, you can leave the game connected and easily switch between watching regular TV and playing with your ColecoVision. The cable that runs from the game console to the switch box is a handy 15 feet long.

Cartridge

A free *Donkey Kong* cartridge comes with every ColecoVision system sold. If this cartridge is any indication, future arcade game cartridges should be excellent home versions of popular coin-op games. *Donkey Kong* is licensed to Coleco from Nintendo, the Japanese manufacturer of the coin-op machine.

Donkey Kong plays just like the original coin-op game, with a few exceptions. There are only three different screens in the cartridge program—there is no conveyer belt board. The screens on *Donkey Kong* are very similar to those in the arcade game, but some things had to be changed when the conversion was made to the home system. Remember, most coin-op arcade games are played on monitors that are higher than they are wide; just the opposite is true of home video games.



Screen 3 of Donkey Kong.

The ROM chip that Coleco currently uses in the ColecoVision cartridges is a 4764. The CPU for the game console is a Z80.

The graphics on the ColecoVision are really impressive. The resolution is much higher than that of the Atari VCS and even the Intellivision. There are several brilliant colors which can all be used on the screen at the same time; *Donkey Kong* even boasts a multi-colored Mario.

The graphics are fast moving and smooth. Things don't appear to jump around on the screen as they do in some Atari VCS games (most notably, Pac-Man). The graphics are comparable in every way to an arcade game.

The Future of ColecoVision

When I spoke to the people at Coleco in late August, they planned to have 15 cartridges available by January, 1983. These were, in order of scheduled release: *Donkey Kong, Venture, Cosmic Avenger, Smurf, Ladybug, Mousetrap, Carnival, Turbo, Victory, Zaxxon, Football, Space Panic, Baseball, Tunnels & Trolls*, and *Space Fury*.

And there is good news for Atari VCS and Intellivision owners, too: Coleco plans to release versions of these games for your systems too, but their release dates are later.

Despite the few faults I found with it, ColecoVision is well on its way to becoming the most popular home video system of the 1980's. Due to its low price and the fact that it is expandable, ColecoVision is not as risky an investment as some of the other home systems. It seems to me that in the future, ColecoVision will be the system that all new game machines will have to measure up to.

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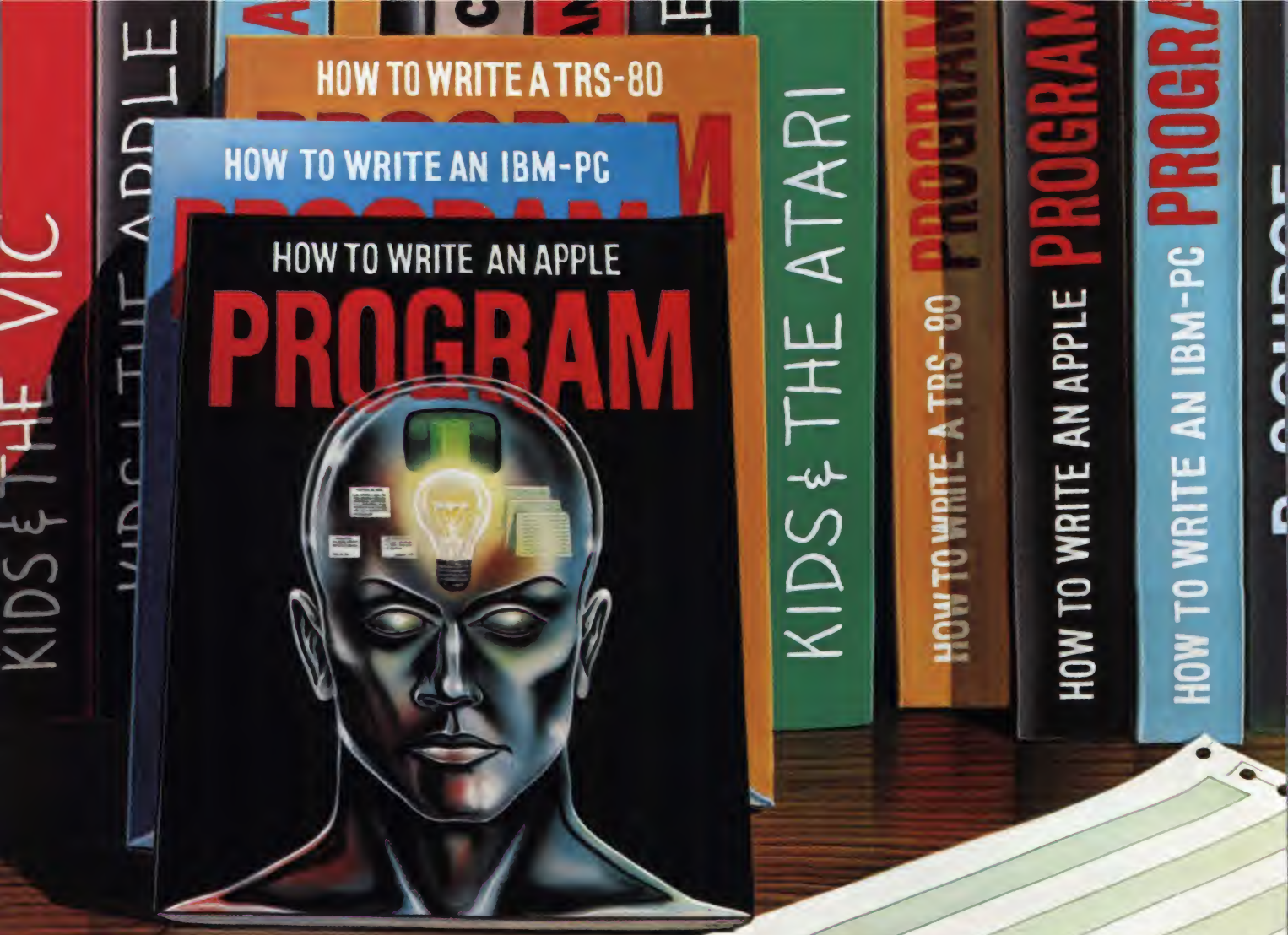

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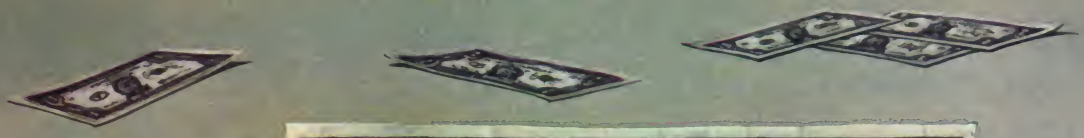

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Choplifter

The Bungeling Empire is Broderbund's favorite adversary. In *Starblazer* the player attacked it with a WWIII jet. The scenario has changed for *Choplifter*, and I'll let you select which country might best represent the Bungelers today.

The Bungelers have taken 64 hostages from the U.N. Conference on Peace and Child Rearing and crammed them into four barracks near the eastern border.

You, the leader of the Sanguinistas, have a helicopter with enough parts for three missions. It is loaded with unlimited fuel, bombs, and rockets.

From your command post (a U.S. Postal Service distribution center) just east of the boundary line, you receive word that one of the barracks has exploded and caught fire. The hostages are running free temporarily, looking for help. This may be your chance.

Lifting off in your helicopter, you hit one of the buttons—the movement button—on your joystick. This spins the chopper around to face west. Push the second button and you fire in the direction you are facing to test your guns.

Pressing the movement again and holding it, you swing all the way east. A short jab at it turns you halfway back, perpendicular to the sentry moon.

Tilt the chopper in the direction you want to go, and you flutter across the border. A Bungeling tank, green against the pink sand below, fires helplessly at you. (It might sound like odd camouflage, but in black and white, the tank is almost invisible.)

You see a hostage waving at you, and another. An enemy tank outraces them as you start to set down. Pull the joystick back, and you lift up again.

You are perpendicular to the tank, so you can drop bombs while it moves back and forth firing. Ease the stick over and push the fire button as fast as you can. The bombs fall and explode with noise and flare on the surface until you hit the tank. All is quiet again for a while.

You land, level the chopper carefully, and watch the hostages come running to your craft.

The animation in this game is amazing. The helicopter lifts and tilts, the 1/4"-tall hostages wave and run, jets come in and turn to fire two rockets, fires and explosions rage...the American flag on the distribution center even appears to wave in the electronic breeze.

Once you have landed the first 16 hostages, you must decide how to free the remaining groups so that you can load and save them.

creative computing
SOFTWARE PROFILE

Name: Choplifter

Type: Arcade helicopter action

System: 48K Apple II or II+, DOS 3.2 or 3.3 disk drive; joystick optional; soon available for the 32K Atari 400/800

Format: Disk

Language: Assembly

Summary: Unending, realistic action.

Price: $34.95

Manufacturer:
Broderbund Software
1938 Fourth St.
San Rafael, CA 94901

Dan Gorlin's program is impressive. The joystick controls are touchy enough to make a novice bounce the 'copter around like it's doing the pogo. The movements of the little hostages are correct down to their wave from the P.O. after they have been freed.

Even the way the jets peel off and fire their miniscule missiles is well done: the aircraft get larger as they get closer and turn into their attack run. The three-dimensional effect is very good.

The player's score is based on the number of hostages safely freed. At the top of the screen are displayed the numbers which tell how many hostages have been killed, how many are aboard the airship, and how many are safely at the distribution center. There is nothing to be gained by blasting tanks, jets, or the smart bombs.

Tanks can only hit the 'copter when it is on the ground loading escapees. The jets can occasionally hit the copter on the ground, and often in the air. The smart bomb will ram in the air, or rain bombs if the craft is loading. You can also fly right into the ground, if you aren't careful.

While you try to save them, hostages will be mowed down by tank fire, rockets, or bombs. They can also be squashed by the helicopter if you aren't careful, or hit by the blade if the machine isn't firmly on the ground.

It is an unusual concept carried out well.

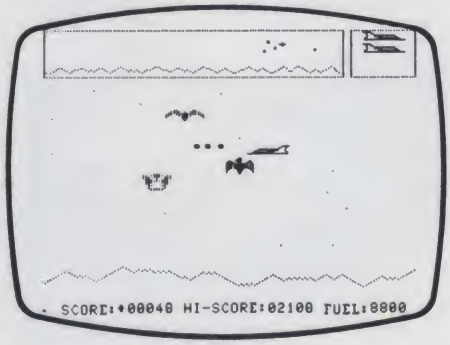
Gorgon

A cloud of sparks glows, then coalesces, shrieking into a winged beast that instantly swoops toward a helpless human on the surface of the planet. In a desperate attempt to dive fast enough to destroy the being, you hammer the control panel on your fighter.

Even as you begin your dive, another cloud of sparks shrieks and begins to form behind you, but you haven't time to deal with that creature yet. It forms a gleaming red head, its jaws opening and closing malevolently, explosive homing eggs spewing from it.

No! Your target has seized the human and is beginning to rise from the earth. You have one chance left. You must blast the creature and catch the human as he falls.

Fire...fire again! Got it! Now to swoop in: saved. Must drop to the surface and release the victim, then climb up to deal with the others.



At the top of your screen, you watch the sensor radar plot of the enemy. The main screen view is but one small part of the entire planet surface. You can, in fact, exit at the left and reenter at the right. So can the creatures.

Scientists believe these beasts have entered earth's atmosphere from a time warp. Perhaps the most dangerous of them are birdlike creatures, some of which launch homing explosive eggs as the head does. Others just attack your fighter. Only one type steals humans—for some purpose you aren't eager to discover. All, however, will destroy your ship by ramming.

To add to your problems, you have a limited amount of fuel. When it runs low you must thread your way through a gauntlet of sensor satellites.

Touch the satellites and you lose a ship, so refueling can be as dangerous as actual battle.

To confound you even more, if you swoop too low when trying to destroy a kidnapping flyer, you kill the human yourself. You know what the media will do with that.

The Gorgons were the Greek triad of sisters that included Medusae. One glance at her head would turn a person to stone. As a result, she is reputed to be the prototypical blind date. (She was about a -10 billion; snakes for hair, you understand.)

None of the gals flew around kidnapping people.

Gorgonize, however, has come to mean petrify (as with fright). *Gorgon* has just the opposite effect: you react fast and wish you were faster.

It is a solitaire space battle with no paddle or joystick control. Instead, you use the keyboard. A moves the ship up, Z puts it into a dive. The arrow keys move it in the corresponding direction, while the space bar fires.

If you press the motion keys rapidly, you enjoy steady progress. Press them moments apart and you move, stop, then move again. This is true for the battle and refueling segments both.

The small sensor screen at the top signals your location with a + sign. You can track the enemy with that, while evading their missiles.

The missile bird tends to head straight for the top of the screen, only dropping when you are in another frame. You must react instantly to destroy it as it swoops.

Nasir seems to have programmed the majority of his creatures to defend the kidnappers. They tend to hover above the scene of the crime, forcing you to manuever well.

You can pause, restart the game, and turn the sound effects off.

This game by Nasir (written before he left Sirius) offers splendid animation, graphics, and appropriate sound. Even a beginner will enjoy it, although he may not do too well at first.

creative computing
SOFTWARE PROFILE

Name: Gorgon

Type: Arcade game of the Defender genre

System: 48K Apple II or II+, DOS 3.2 or 3.3 disk drive

Format: Disk

Language: Assembly

Summary: Another finger-twister from Sirius.

Price: $39.95

Manufacturer:
Sirius Software, Inc.
10364 Rockingham Dr.
Sacramento, CA 95827

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Good evening. I'd like to welcome you to Nightmare Gallery. We have assembled a small group of funloving guys and ghouls to...recruit you.

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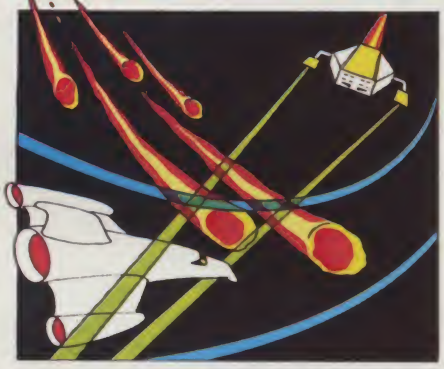

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CIRCLE 271 ON READER SERVICE CARD

I strongly suggest you turn the sound off on your Apple. The sudden shrieks that emanate from it are enough to wake the dead.

It is my sad duty to supply you with these three revolvers and an endless supply of bullets. You will forgive me for pointing at them, I'm sure. I have a slight allergy to silver. I'm also pledged to give you these three temporary shields, proof against the undead...but not our ghost companions.

Our playful little group's desire is to have you join us, permanently. We can't understand your reluctance, and will try to persuade you. Won't you join our party?

You, with your filthy pistol, must try to shoot us as we gambol from tombstone to mausoleum. As we dance from row to row, your fire retires us to whence we came. Strike a fleabitten werewolf; he turns into a mossy tombstone. A handsome vampire bat, however, becomes a striking mausoleum.

Luckily for us, these monuments stop your fire. Oh, you'll chip them away as you continue shooting, but others are built by the mummies and the falling ghosts the ghouls drop. The mummies walk from the top of the screen down toward you, leaving columns of monuments; the ghosts plummet, also adding monuments.

If you hit a ghost as it falls, you won't kill it, but you may gain extra shields. Bullets ripping through the mummy can destroy the monuments it replaces, although the mummy won't be harmed.

As for the rest of us, the werewolves dance from column to column. Two columns side by side give them the shortest path. Should the columns be separated by a space, they will be forced to cross that space, targets for your fire.

Vampires fly down toward you leisurely. Either species may, with a cheery shriek, embrace you and your pistol if they successfully reach the bottom of the screen. The mummy and ghost must fall on you for the happy conversion.

Oh, you can foil our recruiting efforts for a while if you wish to be a spoilsport, by using one of your shields. While it lasts, however, you can't shoot.

You'll even earn extra pistols at three different levels for decimating our ranks.

When at last we gather you into our fold, you will be able to leave a permanent record of your foolish struggle for posterity. If you tire during the fight, you may pause. But should you hesitate during the fight...you'll be retired.

This is splendid Halloween entertainment all year around. Concept and execution are hilarious, and the package cover featuring Robert Clardy and Ron Aldrich's names is excellent. One complaint: there was no envelope to protect the diskette. The package was punched for a three-ring binder, but I keep my disks in a box. Please include envelopes in products.

Oops. I see the sky beginning to lighten in the East. Our little band must leave you now. Don't relax, though. We'll be back again.

creative computing
SOFTWARE PROFILE

Name: Nightmare Gallery
Type: Arcade game in Centipede genre
System: 48K Apple II or II+, DOS 3.3 disk drive; paddles optional
Format: Disk
Language: Machine
Summary: A scream (in the night)
Price: $34.95
Manufacturer:
Synergistic Software
5221 120th Ave., S.E.
Bellevue, WA 98006

Space Eggs

Space Eggs is an early Nasir Gebelli program with lots of movement, color, and smooth animation. Nasir must have been influenced by the movie *Alien* when he designed this one.

In it, you patrol space in your three-piece steam-operated calliope-cum-spaceship, charged with keeping the peace. Your ship divides when you sight the

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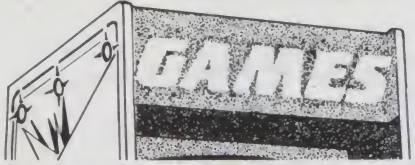


vicious space eggs. You attack first with your single-gun nose wing.

The three-color eggs dance and swirl and change colors at the top of the screen as you sweep back and forth beneath them. Hit one and it hatches to release a space spider. If you fire desperately at the spider to keep it from ramming you, you are liable to hit and hatch another egg.

Clear the screen of the spiders, and more eggs appear. This time, a stricken egg hatches into the dreaded lips. If you escape their kiss of death, you move on to a flight of wolves, followed by hairy-eyed fuzzballs.

Should you fail to shoot all their lights out before they ram you, your second midsection ship sporting two guns replaces the nose wing. However, it begins back with the allotted clutch of eggs, again hatching spiders first.

creative computing

SOFTWARE PROFILE

Name: Space Eggs

Type: Arcade shot-'em-up

System: 48K Apple II or II+
DOS 3.2 or 3.3 disk drive,
paddle or joystick

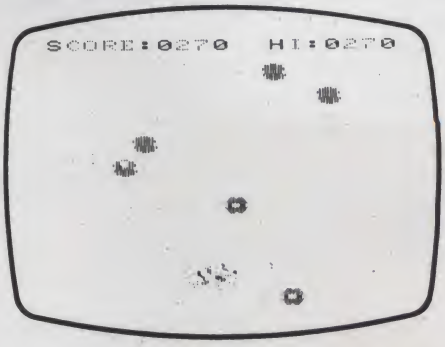
Format: Disk

Language: Assembly

Summary: A twisting, tootling terror

Price: $29.95

Manufacturer:
Sirius Software, Inc.
10364 Rockingham Dr.
Sacramento, CA 95827



If you are lucky enough to get 1000 points with either the nose wing or the midsection, you have an opportunity to duck the first stage with the second. That gives you three shots at once, but the ducking procedure is not easy.

Usually, though, you must bring up your last line of defense. The third and last section of your ship also has two guns, but it is a big target.

The ships respond a bit slowly to the paddle, I felt. I would like to have the shots go faster, too. This is a game for people with quick reflexes and long fuses.

I found no pause feature, nor any way to turn off the sound. *Space Eggs* is an interesting variation on the MBAFAS (Move Back and Forth And Shoot) theme.

Beer Run

I'm going to call this a ladder game, as in the "ladder genre," which includes *Apple Panic* and Donkey Kong.

Genre is one of those critical words writers use to make people think they

creative computing

SOFTWARE PROFILE

Name: Beer Run

Type: Ladder arcade game

System: 48K Apple II or II+,
DOS 3.2 and 3.3 disk drive;
paddle, joystick, or Sirius
Joyport optional

Format: Disk

Language: Assembly

Summary: The Galumphing Gourmet
visits Olympia

Price: $29.95

Manufacturer:
Sirius Software, Inc.
10364 Rockingham Dr.
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know what they're talking about. (At times, it is a polite way to say "copy.")

E.B. White wrote the best description of critical words in *The Elements of Style* (Strunk and White). He termed them "words that at first glance seem freighted with delicious meaning but that soon burst in air, leaving nothing but a memory of bright sound."

Genre, proclaims my dictionary, means a variety or type. It is still a writer's buzzword.

So *Beer Run* is a ladder game. As such, it is at the top of the ladder for animation, speed, and enjoyment.

The game was written by Mark Turmell, and he must have had a ball. The scenario is to catch Artesians, bouncy little characters that abound in the Sirius Building and the Olympia Brewery building next door.

You are a beer runner. Trying to thwart you are green guzzlers (about the color I turn after a few too many), and the bouncers. The guzzlers move across the floors, and up and down the ladders; the brawny white bouncers appear to be confined to one floor.

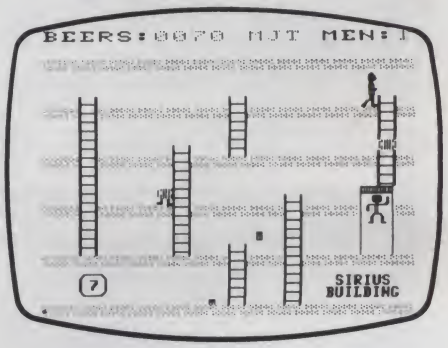
You can see several floors at one time, with ladders between them. At one level is an elevator, which can disappear and reappear on another floor, with an arrow pointing in the direction it is heading.

Using either the keyboard or paddle, you can move back and forth on the screen. By pressing the space bar or paddle button when your runner alter-ego is in an elevator or at a ladder, you can make him move up or down.

Any time you take a ladder that extends to a floor above, you go up. You can only go down on ladders that end at the platform you are on. This is important: if you are on a ladder that extends up and down you always go up.

Your score mounts up in a number of ways and is stored on disk. First, the Artesians will drop cans of beer for you. Each one you catch with your outstretched hand adds another point to your score. Kegs sometimes appear on the screen; collect them and you earn the number of points written on the keg.

You gain 25 beers each time you ride an elevator, plus a bonus depending how close to the Artesians you are.



When you reach the top of the Sirius Building, you have a chance to catch a blimp to the building next door. The blimp lowers a rope. If you catch it on the first try, you earn 200 points and a runner. If you catch it on the second or later pass, you receive 50 points and an extra runner.

Once in the Olympia Building, you must reverse your direction and work your way down to the basement. If you are lucky, you'll nab an Artesian and receive bonus points. Should you reach the basement without doing so, you still earn an extra runner. (You begin with three.)

Avoid being trapped by either the guzzlers or the bouncers. They will defenestrate you (toss you out a window), and the graphic will show you falling.

You can pause the game, restart, and turn off the sound effects. It is fast and funny, but frequently frustrating.

Track Attack

This has to be the game I know the most about. Not because I play it often, however. It and *The Complete Graphics System* from Penguin Software were the subject of an article I wrote about designing commercial software.

Chris Jochumson wrote this because Doug Carlston feels "he does well with things that folllow paths." (Chris also did

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Space Quarks for Broderbund). The execution is topnotch, the colors are bright, the three segments of the scenario are all well done. It simply isn't my cuppa.

The scenario is this: you are a modern-day trainrobber.

You must drive around a trainyard avoiding the onslaughts of a fierce phantom watchman who roars around in a green '52 DeSoto shaped like a lozenge.

A freight train, loaded with gold, tootles through the yard. Every time you crash through the wall of a freight car filled with gold it is transferred to your vehicle.

After you have liberated it, you must store the gold. It can be recovered by the DeSoto lozenge, but you can reliberate the loot by ramming into the phantom. This is the only time it is safe to do so.

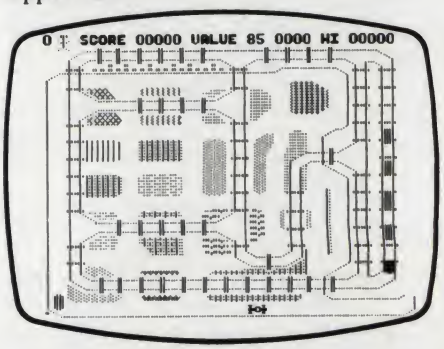
You can't run into the engine or any of the boxcars you have emptied. If you empty all four boxcars before the train refills, you earn another car.

You earn points for the gold and for restealing it from the phantom car, and the faster you are the better. You lose points if the phantom steals it, and more if it deposits the gold back to the train loading area.

Do you still follow me? There's no rest for the wicked yet.

The second level occurs after you have stolen at least one piece of gold. As you roll along the left side of the screen beside the train, you can press the space bar or joystick button. That makes your character leap onto the top of the train.

Next your little person must jump from car to car using the joystick, or the Z for downward tumble, A for upward jumps. If you miss, you go under the train, and lose a player and all the gold you have ripped off.



If you get into the engine, you move to level three of the game. Again avoiding the phantom (those '52 DeSotos must be real juggernauts), you direct the train around the tracks to pick up 11 pieces of gold. Each one worth all the gold you picked up at the first level.

Collect all 11 and you earn another extra character. Bang into the phantom, and there go all points from this level. Press the space bar or joystick button while the train is at the right side to return to the first level and back into your car.

If you notch your disk, you can save the high score to it. You can also turn off the sound, pause, change speeds, restart a game, and reconfigure your joystick or keyboard.

Track Attack is an unusual game requiring good reflexes. Try it; you might like it.

creative computing

SOFTWARE PROFILE

Name: Track Attack

Type: Arcade activity

System: 48K Apple II or II+, DOS 3.2 or 3.3 disk drive; joystick optional; soon available for the 32K Atari 400/800

Format: Disk

Language: Assembly

Summary: The Fair Train Robbery

Price: $29.95

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Apventure to Atlantis

Robert Clardy has been involved with Apples almost since the machine fell off

the tree. He is one of the oldest members of the Apple Pugetsound Program Exchange Library (publisher of Call-A.P.P.L.E.), and is treasurer for the group.

He wrote *Higher Graphics* in 1979. *Odyssey* in 1980 (using Integer Basic) and recently rewrote it in Applesoft. His latest adventure, *Atlantis*, includes real-time arcade action...and it works.

Clardy's *Odyssey* was one of the early text adventures with the added grace of limited animation. *Atlantis* is a much more involved follow-up to Odyssey. It is a standalone game, however.

You begin the game by rolling the following attributes: wisdom, intelligence, strength, and charisma. When I say rolling, I don't mean with dice. Instead, a graphic onscreen scrolls at high speed through the numbers 8-18 for each attribute.

Press any key to stop the roll. You do that for each attribute, and when you are satisfied with them all, you move on. If you aren't satisfied, you begin again.

You also select your alignment and your reaction time.

Alignment lets you decide whether your character is chaotic, lawful, or some thing in between. In cowboy novel terms, the chaotic characters are the loners, while lawful folks make up the posse. If you try to assemble a group of opposed alignment, your morale will be down and you will have problems.

As for reaction time, in the arcade sequences of the game this dictates how much time you have to cope with whatever creature menaces you. If you select 0, you have a straight adventure: nothing attacks or shoots at you. Select 9, and your name had best be Wild Bill Hickok II.

creative computing

SOFTWARE PROFILE

Name: Apventure to Atlantis

Type: Graphic adventure with arcade action

System: 48K Apple II or II+, DOS 3.3 disk drive; paddles optional

Format: Disk

Language: Machine

Summary: Multiventure from a master

Price: $40

Manufacturer:
Synergistic Software
5221 120th Ave. S.E.
Bellevue, WA 98006

Your trip begins on the island of Lapour, where the orb of power of The High One was lost. You find the orb, and must build a group of trusted comrades—guards and wizards—to destroy the island of Atlantis.

The guards *can be* summoned. The wizards must be wooed with promises.

Your view of Lapour is from above. You control the direction of your character's travel, and watch him or her encounter—and perhaps combat—various beasts, from androids and orcs to great apes, ghouls, and land squids. You decide whether to fight or run, then press a key to stop the roll of numbers.

These battles increase your experience, and you can always replace fighters at the castle. Your character will also meet sorcerers' apprentices who can be persuaded to join the quest.

Ornithopters regularly visit the planet from Atlantis to drop off more monsters. If you read your 26-page book of instructions carefully, you will uncover a way to hijack one.

When you are underway, you can select weapons to determine your firepower. Among these are crossbows and guns, plus an assortment of attack spells (if you have any).

Your adversaries in this aerial competition might include submarines you can

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bomb; other ornithopters; Atlantean two-man scout ships; dragons; flocks of gargoyles, harpies, and rocks; air squid, green skulls; dark demons; and warlocks.

Once the enemy appears, you can aim with either the arrow keys or paddle 0. A crosshair appears near your vessel, and enables you to aim. Since your range is limited, you must wait until the enemy is right next to you.

Should you be successful in these forays, you must adjust the heading of your ship according to the prevailing winds, your velocity, amount of fuel, etc. You can adjust your altitude, and when you are comfortable, you can land to refuel.

This is an island world. Once you land on an outcropping, you find deserted castles. Denizens lurk within, but so do the fuel, weapons, and other reinforcement you need to destroy Atlantis.

As you travel from room to room in these castles, you can have either a wizard or a guard at your head. This means there will be either one or the other on the graphic.

The graphics are simple, but quick. They appear onscreen in a second, perhaps because there is little color.

Should a vicious trog appear, you can aim your weapon (arrows are easier to recover than magic spells) and fire. The arrow from the crossbow will transfix it—if you have aimed correctly.

Don't take any potshots at the wizards that appear from time to time. You may be able to bring them to your side if your charisma is high enough. At times, they will get into wizard's duels with your henchpeople.

There are notes, hidden and/or magical objects and doors, and enough puzzles to satisfy the most ardent adventure fan. It might be possible for a person to play through in four or five hours, but it would take dedication.

Unlike most of the other adventure games on the market, *Atlantis* isn't linear. That is, you aren't forced to follow the steps in a certain sequence. Different things depending upon which you choose to explore (although the same rooms appear in each scene).

Once you have completed the game and destroyed Atlantis, everything changes. The rooms shift, random factors are adjusted, and nothing is as it was. You can also increase the speed of the reactions of the attackers.

Commands are mainly one-letter, such as U for "use some object." You can turn off the sound, and save the game until later.

The game has sound, color, animation, excitement, and—for when you're really stuck—a hint sheet. If you find static adventures boring, try this one.

Knight of Diamonds

Wizardry left many of its fans panting for more. Their impatience for a new scenario has been rewarded with *Knight of Diamonds* (KOD).

One player, I am told, completed the quest within a week or so. I wonder why? What fun is there in racing through such a complex and challenging program? Particularly when slow, thorough exploration will bring characters up several

3. How long was this product on the top thirty?

WIZARD AND THE PRINCESS

This adventure game holds an all time record for its long held position on the Softalk top thirty. Once you play the game, you will understand why. WIZARD & THE PRINCESS features some of the most challenging and imaginative puzzles in all adventure-dom and has stumped players all over the world! You can't call yourself a master adventurer until you've played WIZARD & THE PRINCESS. Available from your local computer store for $32.95 or order directly from SIERRA ON-LINE

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levels before they venture deeper into the dungeon.

The scenario in this game is for characters who have advanced through the ranks in *Wizardry* (minimum of 13th level). Bishops, fighters, mages, lords, ninjas, thieves, and other classes must be experienced to survive.

You cannot create characters in this game. You can use only experienced characters from The Proving Grounds. (This is a bit inconvenient when you want to begin a new sacrificial lamb or storage unit.)

Here, too, is a quest, its goal the staff of Gnilda, which projects a totally impervious force field that protects the City of Llylgamyn. Neither magic nor physical attack has been able to penetrate the field.

creative computing
SOFTWARE PROFILE

Name: Knight of Diamonds

Type: Top-of-the-line fantasy adventure

System: 48K Apple II or II+, DOS 3.3 disk drive

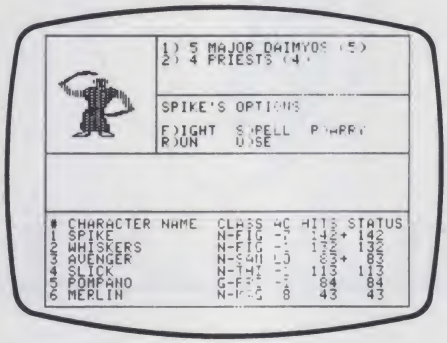
Format: Disk

Language: Run-time Pascal (no special equipment needed)

Summary: Deeper dungeons for your alter egos

Price: $34.95

Manufacturer:
Sir-Tech Software, Inc.
6 Main St.
Ogdensburg, NY 13669



Through treachery it was manipulated by an evil wizard, Davalpus, to seize the throne and slay the royal family of Llylgamyn. Wearing the armor of the fabled Knight of Diamonds, a remaining young prince destroyed Davalpus only to die with him in the ruins of the castle.

Now, the armor must be gathered from the six terrible levels of the ruins and the staff found...or the city of Llylgamyn will fall.

Your quest begins in the city, where you find the familiar franchise operations: Gilgamesh's Tavern, Boltac's Trading Post, the HoJo's Adventurer's Inn, and the famous Temple of Cant.

The game uses the *Wizardry* system and graphics. Most commands are one-keystroke. You have direct control of each person in your party (as many as six). Only three characters can fight with weapons at one time, although magic-users can fire spells over the front line.

Monster groups are tough, and many of them are new species. Often, there are four groups of up to nine beasts per group. There are swarms of insects, wereprides of weretigers, clouds of fuzzballs, dwarf-like men called dinks, bats, snakes, and other vermin.

Even though the battles are much tougher, the treasures reflect this: they are more generous. Also, you garner more experience points during battle than in Proving Grounds.

Warning: the Magician General has

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determined many of these are dangerous and should be used at your character's risk.

Characters can be drained of levels by some creatures (undead, for the most part) more than once. If you have a good character who is drained, turn the machine off immediately before the damage is recorded. (You will also lose all points and magic items discovered on that particular expedition. You won't, however, be charged 10 years on this new version.)

If you do turn off the machine it is possible that the important pieces of *KOD* armor found on that expedition—or traded after you form a party—could be lost if you go back to the training grounds before you go below. So don't flip the switch indiscriminately.

Some spells work differently in *KOD* than they do in Proving Grounds. One new feature is that no one in either the player's party or the enemy group can throw spells for the first melee of a surprise attack.

Author Robert Woodhead said about this new game: "Things are not always what they seem." He also feels that the riddle on the sixth level is "a real killer" even though he thinks the answer is very obvious.

Altogether, now that the initial bugs have been exterminated, this game is a worthy sequel to *Wizardry*.

Caterpillar

Atari struck it rich last year when they introduced the coin-op video game Centipede. It was, for the most part, a high-speed shoot 'em up with cute graphics that appealed to men and women alike. Not surprisingly, the arcade Centipede was soon followed by home computer versions. *Caterpillar*, from Aardvark Software is one of the best adaptations of the original arcade game.

Caterpillar is a fast paced game written in machine language. It supports only one player using the right joystick. In the game, you have three shooters with which you must destroy an onslaught of attacking insects.

Your base is situated at the bottom of a mushroom patch. A large caterpillar starts off at the top of the patch. Each time a segment runs into a mushroom, it drops down a level and reverses direction. Shooting a caterpillar segment turns it into a mushroom and causes the creature to split in two.

In addition to the caterpillars; spiders, fleas, and scorpions also infest the mushroom patch. If your shooter collides with any insect, it is destroyed.

Caterpillar plays very much like Centipede, with a few exceptions. Your shooter

creative computing
SOFTWARE PROFILE

Name: Caterpillar
Type: Arcade
System: TRS-80 Color Computer 16K
Format: Cassette/disk
Language: Machine
Summary: Playable game of Centipede
Price: $19.95 cassette, $21.95 disk
Manufacturer:
Aardvark Software
2352 S. Commerce
Walled Lake, MI 48088

7. What can be on level three that can help you to the top of the hill in a hurry?

in

Cannonball Blitz

As a little soldier in CANNONBALL BLITZ you've run your legs off to scurry up two screens full of uphill battle. What leg saving device will you find on the third screen to get you up the hill in a hurry?
Find out when you play CANNONBALL BLITZ but watch out!! Fast, smooth animation and escalating levels make this game potentially addicting. Available from your local computer store for $34.95 or order directly from SIERRA ON-LINE.

Available on APPLE
SIERRAVISION

Sierra ON-LINE INC
36575 MUDGE RANCH ROAD COARSEGOLD, CA 93614
TLX 910 362 5025 209 683 6858

8. How many times can a monster be reincarnated?

Play

CROSSFIRE

You will swear you didn't miss and you'll be right. The aliens are coming from everywhere and to eliminate one, you must hit it several times. With each hit, the monster gets uglier and meaner. How many times do you have to hit the advancing alien before he stops his attack? Find out when you play CROSSFIRE. Available from your local computer store for $29.95 or order directly from SIERRA ON-LINE.

Available on APPLE, ATARI, IBM, and NEC
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Interfacing the Grappler+ to a wide range of printers is easy as changing a dip switch. 4K of exclusive firmware makes the Grappler+ the most intelligent, full-featured Apple® Printer Interface made. And, the Grappler+ is Apple III compatible.*

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*Requires additional software driver.
**Requires graphics upgrade.

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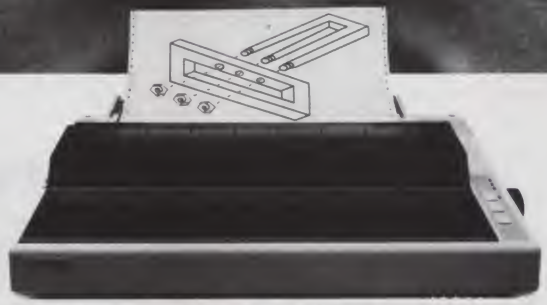
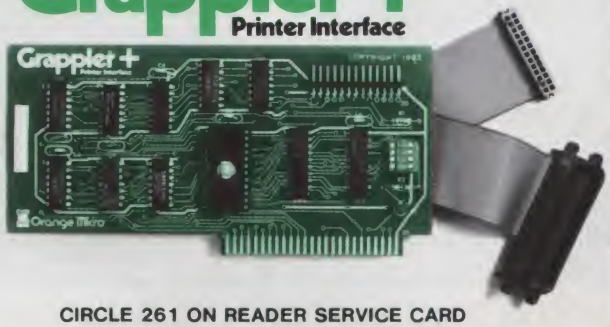


ACTUAL APPLE II PRINTOUT USING GRAPPLER AND EPSON MX100

With The Grappler+™ Printer Interface



CIRCLE 261 ON READER SERVICE CARD

The Grappler+ Features:
• Dual Hi-Res Graphics • Printer Selector Dip Switch • Apple III Compatible* • Graphics Screen Dump • Inverse Graphics • Emphasized Graphics • Double Size Picture • 90° Rotation • Center Graphics • Chart Recorder Mode • Block Graphics • Bell Control • Skip-over-perf • Left and Right Margins • Variable Line Length • Text Screen Dumps.

The Grappler+ also works with Pascal and CPM.

The Grappler+ interfaces with the following printers:
• Anadex • Centronics • Datasouth • Epson** • NEC • C-Itoh • Okidata**

The original Grappler is available for IDS 460, 560, Prism, Microprism.

Orange Micro Inc.
3150 E. La Palma, Suite G
Anaheim, California 92806
(714) 630-3620

Foreign Dealer Inquiries Welcome TX183511 CSMA

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Apple is a registered trademark of Apple Computer, Inc

is over-responsive to the joystick controls. Simply pressing the joystick to the left causes your shooter to jump almost instantaneously all the way to the left side of the screen. Scoring in *Caterpillar* is almost identical to that in Centipede.

The graphics in *Caterpillar* are hi-res, although they really don't look it. There are many colors and shapes, but unfortunately they appear very blocky. The screen colors don't change after every wave of insects as they do in Centipede, but that doesn't affect game play. The movement of the caterpillar and other insects is very smooth; there is no flicker at all.

Caterpillar produces sound effects only when something is destroyed. Since it has been determined that almost 50% of the appeal of an arcade game is the audio effects, *Caterpillar* falls short in this area. Although it lacks enticing sound effects, the game does offer a great challange. It is very difficult to score over 20,000 points, and almost impossible to master the game.

I recommend *Caterpillar* to anyone who is more interested in game play than exciting graphics and sound effects.

Katerpillar

Wait a minute, didn't I just review this? Yes, and no. *Katerpillar* is pronounced the same as *Caterpillar* and they are both TRS-80 Color Computer adaptations of Centipede. The difference between the two programs is easy to explain. *Caterpillar* plays much more like the arcade game, and *Katerpillar* offers nicer graphics and more pleasing sound effects.

Since *Katerpillar* is modeled after Centipede, its description is similar to that of Caterpillar. Rather than rehash the basic information, let's discuss the program itself. After EXECuting *Katerpillar*, you are presented with a very professional banner page. After the program displays the scoring table, you play the game.

The graphics in *Katerpillar* are very crisp, hi-res shapes. The choice of colors is good and pleasing to the eye. As in *Caterpillar*, the insects move smoothly and don't flicker on and off.

Katerpillar is not a silent game; everyting you do is accompanied by sound effects.

I can find only two faults with *Katerpillar*. Sometimes the centipedes don't drop down as they are supposed to; they get caught in an endless loop until you shoot away one of the mushrooms upon which they continue to bounce. The other thing I didn't like about *Katerpillar* is that your shooter can move up and down only within two horizontal rows. This severely limits your movement and makes the game for two difficult.

If you enjoy Centipede, but like pretty colors and flashy programming, *Katerpillar* is better than *Caterpillar*. Unfortunately there is no program available that combines the playablility of one with the professionalism of the other; you must decide which is more important to you.

creative computing
SOFTWARE PROFILE

Name: Katerpillar
Type: Arcade
System: TRS-80 Color Computer 16K
Format: Cassette
Language: Machine
Summary: Professional adaptation of Centipede
Price: $24.95
Manufacturer:
Tom Mix Software
3424 College N.E.
Grand Rapids, MI 49505

9. What kind of a game can you make with

END GAME

END GAME is a fun, flexible, new way to create some of the best entertainment available for home computers. END GAME is the type of tool that Crowther/Woods would have used to create their game IF it had been available. END GAME is your way to write the game that you always knew existed in the back of your mind — but you never had the time and knowledge to program. END GAME is a useful utility for creating the type of game that many schools are using to promote computer literacy and analytical thinking.
What is END GAME? Find out at your local software dealer or from SIERRA ON-LINE INC. Find out how much creative fun you can buy for $39.95.

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10. Which top Apple originator recommends

LISA 2.5

His friend Steven Jobs helped him develop the Apple II and LISA 2.5 helps him develop machine language programs for it.
LISA does the same for other top programmers including graphics wizard Mark Pelczarski, Hi-Res adventure author Ken Williams and arcade author Olaf Lubeck. LISA is an assembler in use by people that use them everyday. Take a look at LISA 2.5. We think you'll agree with the Apple inventor(—)? (we won't give you the name). LISA is available at your local computer store for $79.95 or order directly from SIERRA ON-LINE.

Available on APPLE
SIERRA BUSINESS PRODUCTS
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The Smith-Corona TP-1 is the only letter-quality printer for under $900.* No wonder it's so popular!

The Smith-Corona® TP-1™ Daisy Wheel Printer.

Big problem! You want to get a beautiful, letter-quality printer. Yet you want to keep costs down. Welcome solution: the Smith-Corona TP-1.

It's the only daisy wheel printer on the market that sells for under $900. So you can get the print quality you really want in a printer, at a price that's well within your budget. (In fact, it's so reasonable, you may find you want a TP-1 even if you already own a dot matrix.)

The TP-1 is just right for small businesses or in-home users. No wonder it's already a huge success!

The print quality of the TP-1 stands up against printers costing three times as much. In fact, you'll get results identical to those of the finest office typewriters. So you'll never again have to send an important letter that doesn't look important.

The TP-1 is also suitable for reports and manuscripts. Even budgets and forms.

Just as important, the TP-1 is amazingly simple to operate. And it's compatible with most microcomputers and available with either standard serial or parallel data interface.

The basic TP-1 handles letter and legal sized paper. A tractor feed option to handle either fanfold or single sheet paper will be available soon. There's a choice of easy-to-change, state-of-the-art daisy print wheels. And ribbon cassettes that just drop in —simple as that.

One other thing: unlike many printers, the Smith-Corona TP-1 is made in America.

So don't settle for a dot matrix printer when you can find (or add) real letter-quality results at an incredibly low price. With the Smith-Corona TP-1 daisy wheel printer. **Smith-Corona**

Please send me information on the Smith-Corona TP-1 daisy wheel printer.

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Title_____

Company Name_____

Business Address_____ ☐ check if dealer

City_____ State_____ Zip_____

Mail coupon to:
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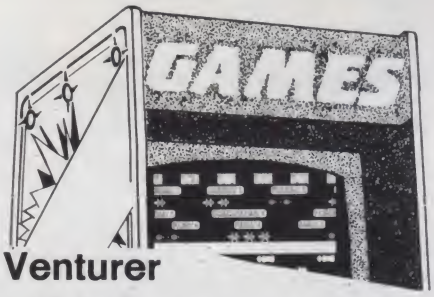
Smith-Corona
65 Locust Avenue, New Canaan, Ct. 06840 CC-12

*Manufacturer's suggested retail is under $900, but prices may vary.

CIRCLE 315 ON READER SERVICE CARD



Venturer

Exidy's Venture video game was the first to use arcade game action in a fantasy role-playing scenario. The player, Winky, delves into treasure-filled rooms armed with only a bow and arrows. *Verturer*, from Aardvark Software, is a Color Computer program based on Venture.

Winky is a small, circular figure who has only one goal: to grab treasures while avoiding the monsters that guard them. In *Venturer,* there is one large room composed of four smaller sub-rooms. Each sub-room has one treasure in it. When Winky enters a room, a picture of the room, the treasure, the monsters, and Winky expands to fill the screen. The player must fight his way to the treasure, grab it, and quickly run from the room.

Players in *Venturer* use the right joystick to manuever Winky and aim arrows; the left joystick is used to pause the game if necessary. Pressing the button on the right joystick causes Winky to fire an arrow in the direction he is pointing. If the arrow hits a monster, it turns into a gravestone and after a while, disappears.

The sound effects in *Venturer* are very nice; better than in most Color Computer programs. *Venturer* is a machine language program that uses hi-res graphics. Unfortunately, the program does not use overlay routines that allow one shape to pass over another without destroying one of them. This could have been done differently and the effect would have been much more professional. As the program now stands, if one object passes over another, the one on the bottom is masked out.

There is on-screen scoring in *Venturer*, but no indication as to how many men you have left. You win free men at various point intervals.

Although the four rooms are always the same, the monster and treasure shapes differ at advanced levels. Unlike Venture, in *Venturer*, each room of a specific level contains the same treasures. After you have grabbed all four treasures, you advance to the next level where the treasures are different. The monsters and treasures are merely graphic shapes; they always act in the same manner, yet they appear to be different.

One difference between this program and the coin-op game is that instead of Hall Monsters coming into a room if you stay too long, barricades are built. A barricade starts at the top of the screen and slowly a line is drawn down. If you are caught on one side of a barricade and the door is on the other, there is no escape.

Venturer, although it doesn't offer the amount of variety found in the arcade game, is a well written Color Computer program. It plays like its coin-op cousin and is sure to please a variety of computer users.

creative computing

SOFTWARE PROFILE

Name: Venturer

Type: Fantasy/arcade

System: TRS-80 Color Computer 16K

Format: Cassette/disk

Language: Machine

Summary: Best Venture program on the market

Price: Cassette $19.95/disk $21.95

Manufacturer:
Aardvark Software
2352 S. Commerce
Walled Lake, MI 48088

11. What does E-P-F stand for?

EPF IV

Extra-Powerful FORTRAN? Easily programmed FORTH? The exact meaning of the initials is for you to define, but we can tell you that EPF IV makes programming easier.
EPF IV lets you use the power of the Apple to help you program by letting the Apple do work like keeping track of line numbers and maintaining files. It also offers a powerful Applesoft editor that provides functions like global search and delete, global replace, copy and move block of text and other functions that you currently use with your word processor. Cut out the redundancy of Applesoft code in your program and let the computer do the boring work for a change. Experience Programming Fun. Check out EPF IV. Available now at your local computer store for $79.95 or order directly from SIERRA ON-LINE.

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12. What popular office furnishing is threatened with extinction because of the 2.0 release of

THE GENERAL MANAGER

They are being replaced and recycled all over America — as more people learn about the computerized filing system that works for you not vice-versa. The GENERAL MANAGER lets you set up the same filing system on your Apple that you currently have stored in your outdated office product — but now the system works for you! All the information in your filing system suddenly comes together so you get facts and files that you need — FAST!! GENERAL MANAGER 2.0 is easily customized and comes with complete easy-to-read documentation. GENERAL MANAGER is making office furniture obsolete at local computer stores everywhere or by ordering directly from SIERRA ON-LINE.

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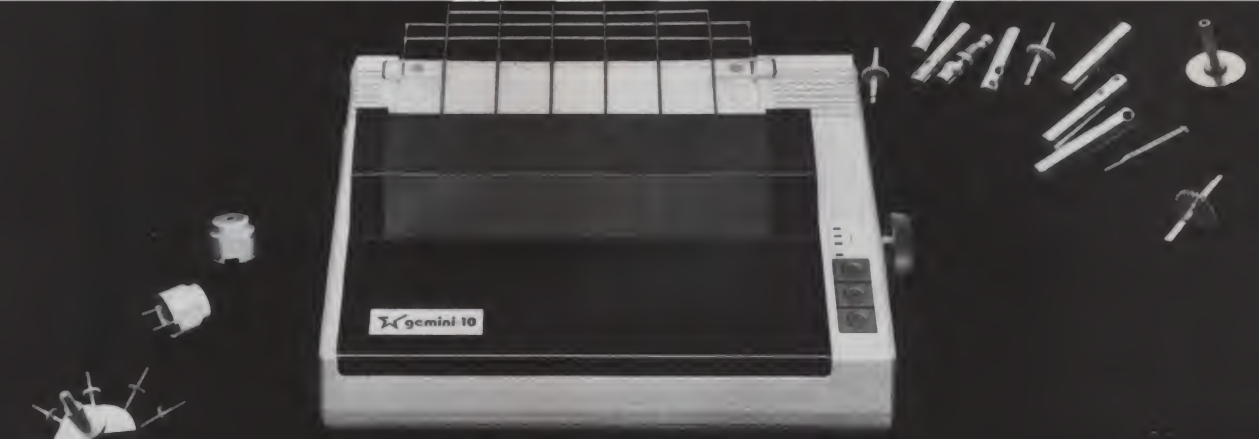
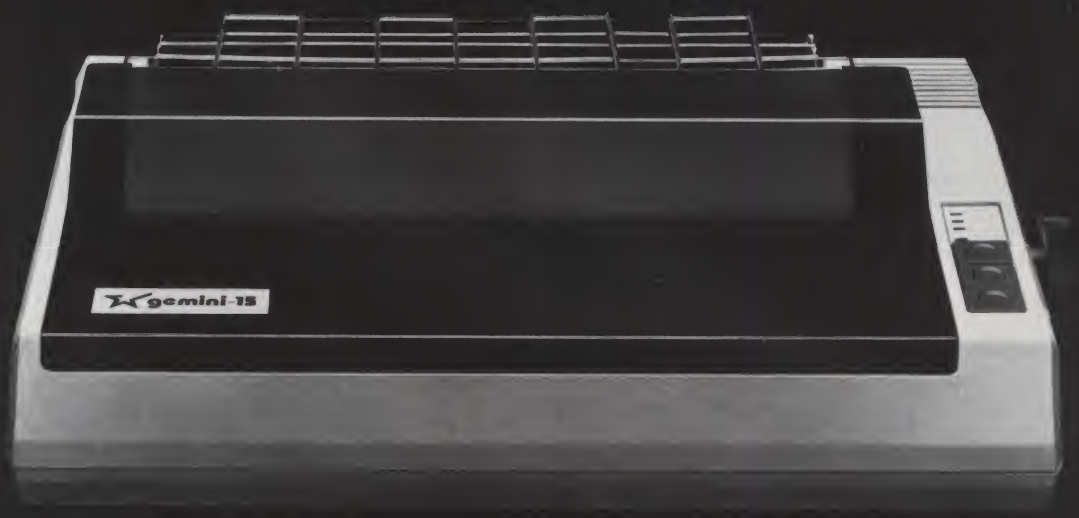


GEMINI–
FOR PRINTER VALUE THAT'S OUT OF THIS WORLD



Over thirty years of down-to-earth experience as a precision parts manufacturer has enabled Star to produce the Gemini series of dot matrix printers—a stellar combination of printer quality, flexibility, and reliability. And for a list price of nearly 25% less than the best selling competitor.

The Gemini 10 has a 10″ carriage and the Gemini 15 a 15½″ carriage. Plus, the Gemini 15 has the added capability of a bottom paper feed. In both models, Gemini quality means a print speed of 100 cps, high-resolution bit image and block graphics, and extra fast forms feed.

Gemini's flexibility is embodied in its diverse specialized printing capabilities such as super/sub script, underlining, backspacing, double strike mode and emphasized print mode. Another extraordinary standard feature is a 4k buffer (with an additional 4k on the serial board). That's twice the memory of leading, comparable printers. And Gemini is compatible with most software packages that support the leading printers.

Gemini reliability is more than just a promise. It's as concrete as a 180 day warranty (90 days for ribbon and print head), a mean time between failure rate of 5 million lines, a print head life of more than 1 million characters, and a 100% duty cycle that allows the Gemini to print continuously. Plus, prompt, nationwide service is readily available.

So if you're looking for an incredibly high-quality, low-cost printer that's out of this world, look to the manufacturer with its feet on the ground—Star and the Gemini 10, Gemini 15 dot matrix printers.

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CIRCLE 336 ON READER SERVICE CARD

Galax Attax

Spectral Associates was one of the first software firms to produce games exclusively for the Color Computer. *Galax Attax* is their licensed version of Midway's popular Galaxian arcade game.

creative computing
SOFTWARE PROFILE

Name: Galax Attax

Type: Arcade

System: TRS-80 Color Computer 16K

Format: Cassette

Language: Machine

Summary: Licensed version of Galaxian

Price: $21.95

Manufacturer:
Spectral Associates
141 Harvard
Tacoma, WA 98466

Like most arcade games for the Color Computer, *Galax Attax* is a one player game. As in Galaxian, you have three laser bases located on the bottom of the screen. A convoy of invaders looms overhead. Occasionally, individual aliens break out of formation and attack your ship. Shooting attacking aliens is worth more than killing them while they are in the convoy.

You move your ship across the bottom using the right joystick. Pressing the button fires one laser shot into the air. Your ship seems to hop along the screen rather than slide across as you would expect it to. It is hard to control the movement of your ship accurately.

Galax Attax boasts one of the most colorful hi-res playscreens I have seen on the Color Computer. The small stars in the background slowly scroll, given the illusion of three dimensions. The alien movements are fluid, not jumpy.

There is a graphic representation of the number of ships left and a running total score. The game itself is challenging and fun to play. The sound effects are never ending. In addition to the sounds of explosions, diving ships, and laser bursts, there is always the droning noise from the engines. All in all, *Galax Attax* is a very enjoyable game--which remains true at all times to its parent, Galaxian.

Berserk

In the arcades, Stern's Berzerk game has a large following. When Atari released their home VCS version of Berzerk back in August, the demand for the game almost cleared the shelves. Not surprisingly, Color Computer owners also want to enjoy the thrill of Berzerk--luckily, there is *Berserk* from Mark Data Products.

In *Berserk*, you play a human trapped in a maze complex. Killer robots have been unleashed to see that you do not escape. You must destroy robots by

creative computing
SOFTWARE PROFILE

Name: Berserk

Type: Arcade

System: TRS-80 Color Computer 16K

Format: Cassette/disk

Language: Machine

Summary: Adapation of Berzerk

Price: $24.95/$29.95

Manufacturer:
Mark Data Products
23802 Barquilla
Mission Viejo, CA 92691

13. What free health service does the popular arcade game

have to offer?

Imagine, if you can, being set loose in a candy store to munch all the goodies you can possibly eat! Race around the store with your jaws chewing away, but beware of the rowdy kids loose in the store. They play a little rough and can be a real pain in the tooth! After you've eaten your fill, we have a special feature that may help reduce cavities. To find and take advantage of our free services, try a JAWBREAKER. Available from your local computer store for $29.95 or order directly from SIERRA ON-LINE.

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SIERRAVISION
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14. How many parachutes can fall before you are the victim of

In this fast-action arcade game, you are seated behind the working end of a powerful gun base. You must use this anti-aircraft weapon to single handedly fight off the rain of helicopters and their cargo of parachuting saboteurs. Watch out for jets equipped with lethal homing bombs, if you let any of them go, it's all over for you! How many parachutes can hit the ground before you experience SABOTAGE? Available from your local computer store for $24.95 or order directly from SIERRA ON-LINE.

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The speed and power of an IBM PC on a $345 Apple® card.

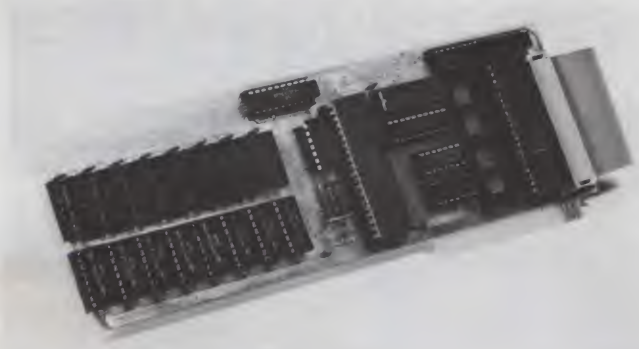
FAST 5 MHZ OPERATION, TRUE MULTIPROCESSING

ALF's AD8088 Processor Card adds a fast 16-bit 8088, the processor used in the IBM PC, to your Apple II. It runs programs from its on-board memory at a full 5 MHz—12% faster than the IBM PC—while the Apple also runs at full speed. And two or more AD8088's can be used in one Apple, to tackle problems that are beyond many mainframe systems.

CP/M-86 AND 192K MEMORY

CP/M-86®, the 8088 version of the industry standard CP/M operating system, is available for the AD8088 for only $200. AD8088 CP/M-86 uses the popular Microsoft Softcard® disk format so you can buy the latest programs direct from major software distributors like Lifeboat Associates.

CP/M-86 uses only 18K, leaving 46K for programs on a 64K Apple—easily enough memory to assemble 12K of object code. For large programs, our $370 AD128K Memory Card provides 110K program space, or 174K program space (192K system memory) for an extra $75.



THE 8087 NUMERIC DATA PROCESSOR

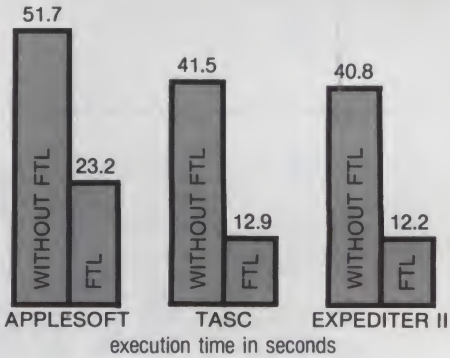
The AD128K Memory Card features a socket for the Intel 8087 Numeric Data Processor. The 8087's 80-bit internal format gives 18 digits of accuracy (Applesoft has only 9). Its speed is equally impressive: it multiplies two 80-bit floating-point numbers faster than the Apple runs 10 machine codes!

FASTER APPLESOFT FOR SCIENTIFIC & ANALYTICAL PROGRAMS

Any program can be rewritten for fast operation with the 8088, but ALF's "FTL" program speeds up math in your existing Applesoft programs—without modification. FTL is activated simply by typing RUN FTL. Programs produced by TASC® or Expediter II® also run faster. The graphs below show the dramatic improvement with FTL.

```
10 PRINT "2 3 ";
20 FOR B = 5 TO
   1000 STEP 2
30 FOR C = 3 TO
   SQR(B) STEP 2
40 IF B/C = INT
   (B/C) THEN 70
50 NEXT
60 PRINT B;" ";
70 NEXT B
```

Program to compute prime numbers from 2 to 1000.



RELIABLE LOW POWER OPERATION

The clean design of the "AD" series separates the two main components—processor and expansion memory, when needed—on two cards. Low-power components are used for cooler operation: each card draws less than an Apple ROM card—far less than a typical 80-column card.

SEE YOUR APPLE DEALER TODAY

An Apple II computer with 64K (48K plus Language Card equivalent) and 13- or 16-sector disk drive is required. The AD8088 and AD128K can be used in any slot.

Trademarks: "Apple": Apple Computer, "TASC", "Softcard": Microsoft, "Expediter II": Einstein/Goodrow, "CP/M-86": Digital Research

ALF

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(303) 234-0871

CIRCLE 106 ON READER SERVICE CARD

shooting at them, but no matter how many you kill, you can never escape. Coming into contact with either the electrified walls or the robots is deadly. If you wait in a room too long, a smiling Evil Orville chases you out or kills you.

Berserk plays just like the arcade version, only a little bit slower—even though it is written in machine language. One or two players may compete, alternating turns. You use the joystick to move your man through the maze. If you press the fire button, you stop and shoot in the direction that you were moving.

There is no on-screen scoring, nor any indication as to the number of men remaining. When you lose a man, the computer switches to a lo-res screen that shows you this information.

The colorful hi-res graphics of *Berserk* surpass even those of the original arcade game. The movement of the player is very smooth; it actually looks like a real human running. The animation of the robots is equally impressive.

Berserk has nice sound effects that enhance game play. One thing I have found that detracts from the game is the fact that many rooms repeat themselves. In the coin-op version, each room is created randomly whereas in Berserk the rooms seem to be in memory. This leads to rather repetitious playing.

Aside from this small fault, I found *Berserk* a very enjoyable game.

Astro Blast

Another game from Mark Data Products that originated in the arcades is *Astro Blast*. The coin-op game it is modeled after, Astro Fighter, never really enjoyed much success in the arcades. This is strange because it has been imitated on all of the popular home computers.

In *Astro Blast* you control a laser base situated on the bottom of the screen. On each of the first three boards, there is a group of one type of alien. When you destroy an entire group, you advance to the next board. After clearing all three boards, you must dock to replenish your fuel supply; if you run out of fuel, the game is over.

Astro Blast requires the right joystick only, even if two players are competing. Your ship is very responsive to the joystick controls, but not overly so. The movement of both the aliens and your ship is as professional as in the arcade version.

The explosions in *Astro Blast* are perhaps the nicest I have seen in any game—on any computer. The graphics are hi-res and extremely colorful. There are sound effects linked to every action which add to the playability of the game.

I think that *Astro Blast* is one of the best-written arcade games currently available for the Color Computer. It is a very faithful adaptation of Astro Fighter and well worth the price.

creative computing
SOFTWARE PROFILE

Name: AstroBlast
Type: Arcade
System: TRS-80 Color Computer 16K
Format: Cassette/disk
Language: Machine
Summary: One of the best space shoot 'em ups
Price: $24.95 cassette, $29.95 disk
Manufacturer:
Mark Data Products
23802 Barquilla
Mission Viejo, CA 92691

15. What shocking and terrible sound could you possibly hear in a game called

LAFF PAK

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16. How many men are in the spaceships of

Marauder

Attempting to destroy the power center on a planet with a progammed defense system and a race of robotic sentries is one of the most dangerous jobs in the galaxy. Many warriors from all sectors of space have tried, and disappeared forever. That's why it's necessary for several men to try. How many fighters can exit a spaceship and attempt to become the victorious MARAUDER? Available at your local computer store for $29.95 or order directly from SIERRA ON-LINE.

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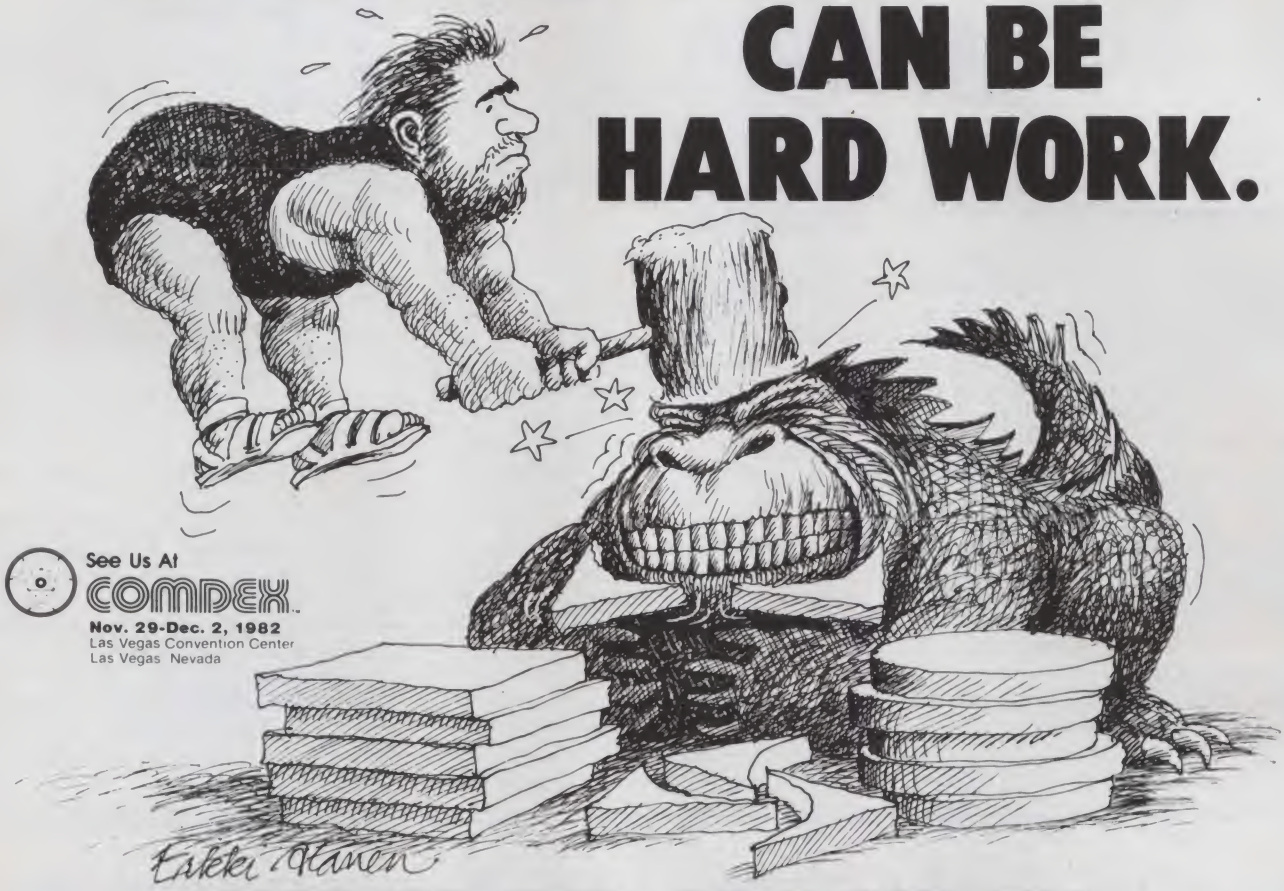

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CIRCLE 338 ON READER SERVICE CARD

War Kings

The preceding six reviews have dealt with programs that are conversions of coin-op arcade games. This review and the next, however, concern adaptations of games that run on the Atari VCS. *War Kings* is a Color Computer version of Atari's Warlords. Warlords itself is an advanced version of Breakout.

creative computing
SOFTWARE PROFILE
Name: War Kings
Type: Arcade
System: TRS-80 Color Computer 16K
Format: Cassette
Language: Machine
Summary: Warped version of Breakout
Price: $19.95
Manufacturer:
Tom Mix Software
3424 College N.E.
Grand Rapids, MI 49505

In *War Kings*, each player controls a shield that deflects a bouncing bullet. The object is to protect your castle while trying to penetrate your enemy's. Each time the bullet bounces off the castle, it chips away a piece of the wall. Once a hole has been carved all the way through the wall, the bullet can pass through and hit the king. When that happens, the game is over.

Each player uses one joystick to maneuver his shield around the outside of the castle. The shield does not slide wildly, but rather, in a normal manner. Unfortunately, the bullet doesn't seem to respond to attempts to put english on it. You cannot spin the shield quickly just as the bullet hits it, and cause it to change its path radically.

War Kings is written in machine language and uses hi-res graphics. The playfield has lots of color. The only thing that moves in addition to your shields, is the bouncing bullet. The bullet follows logical paths, depending on the angle of deflection. The sound effects in *War Kings* provide an enjoyable addition to the rather limited game play.

War Kings is similar to a two player version of Warlords on the Atari VCS. If you enjoy Warlords, or Breakout for that matter, you will probably have lots of fun playing *War Kings*. With three selectable levels of difficulty, *War Kings* can provide a challenge for just about any contender.

Catch 'Em

Catch 'Em is the first Color Computer version of Activision's immensely popular *Kaboom*. After playing *Catch 'Em*, I'm sure you'll agree that no other adaptation of this Atari VCS game need be written.

In *Catch 'Em*, the object is to catch all of the falling articles (aliens) with your paddles at the bottom of the screen. You

creative computing
SOFTWARE PROFILE
Name: Catch 'Em
Type: Arcade
System: TRS-80 Color Computer 16K
Format: Cassette/disk
Language: Machine
Summary: Similar to Kaboom
Price: $19.95 cassette, $21.95 disk
Manufacturer:
Aardvark Software
2352 S. Commerce
Walled Lake, MI 48088

17. What winged defense system emits a deathbolt of fire in

PEGASUS II

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18. Name one piece of hardware that

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CIRCLE 297 ON READER SERVICE CARD

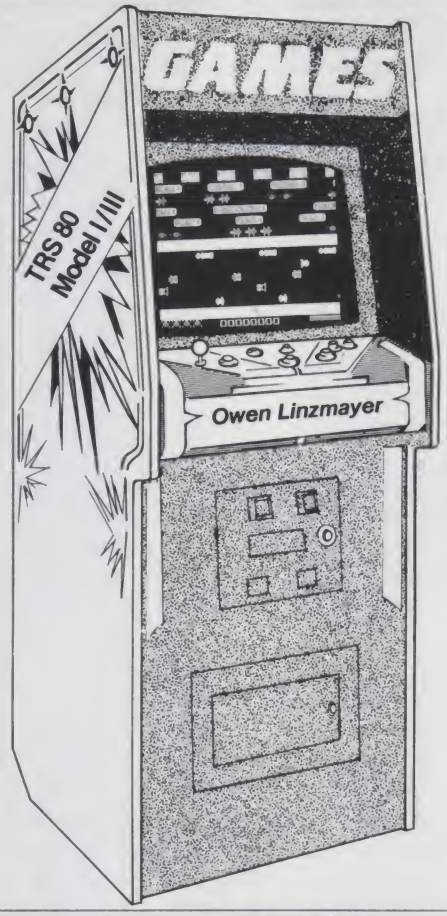
start off with three paddles stacked on top of each other. If you let an object pass below the bottom paddle, you lose the lowest paddle of the stack. When all of your paddles are gone, the game is over. Objects are dropped in clusters from the top of the screen. You must simply touch an object with any paddle to "catch" it.

You use the right joystick to manuever your paddles around the screen. Pushing the fire button launches a group of aliens. There is a total of 16 groups per attack wave. Each group of aliens is different in appearance. This variety is one of the things that make *Catch 'Em* such a fun game.

Catch 'Em, like all good programs, is written in machine language. The graphics are hi-res and plentiful. The aliens are very detailed and colorful, and the sound effects are nice, when they are there.

Although I find the game a bit simple during the first wave or two, it does eventually speed up and become very difficult. Children and less coordinated adults will find that *Catch 'Em* provides a challenge without being insultingly easy.

Catch 'Em is one of my favorite relaxing games. After battling aliens and blowing things out of the cosmos, it is nice to play a game in which everything is not out to kill you.



Bounceoids

In *Asteroids*, leaving the edge of the screen in any direction results in the player reappearing on the opposite side. This feature is called "wrap-around."

What do you think would happen if you took the popular arcade game, Asteroids, and removed the wrap-around func-

creative computing
SOFTWARE PROFILE

Name: Bounceoids
Type: Asteroids variation
System: TRS-80 Model I/III
Format: Cassette/disk
Language: Machine
Summary: Very good arcade game
Price: Tape $15.95, disk $19.95
Manufacturer:
The Cornsoft Group
6008 North Ketstone Ave.
Indianapolis, IN 46220

19. Name one piece of hardware and one large book that

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tion? *Bounceoids*, the new machine language program written by Robert Pappas, is very similar to that, but much, much more.

The concept of a game of Asteroids without the wrap-around is novel enough, but *Bounceoids* has a slew of added features to tempt the arcade addict in us all. *Bounceoids* offers the traditional features such as bonus ships, high scores, multiple skill levels, a two-player mode, and fast graphics. It also has *many* different challenge stages, sound effects, two sets of keyboard controls, and a variety of strange bounceoid creatures out for blood—your blood.

Bounceoids comes on a self-booting disk that works on both the TRS-80 Model I and III. The internal documentation is well written and explains the controls, point system and how the game is played. You are then prompted to enter the number of players (1 or 2) and the skill level (0-9). Regardless of the level you enter, it will increase at every 10,000 points, until eventually it reaches nine.

If you are playing a two-player game, each player may choose a different starting skill level. This is similar to the start-up sequence found on the coin-op game, Tempest by Atari. It is nice to see programmers making their games function more and more like true arcade games.

The graphics on *Bounceoids* are fast and smooth—even when the screen is filled with objects in every possible direction.

Controlling your ships is easy. You have the choice of using one of two different sets of keyboard controls or a joystick. One of the sets of keyboard controls is identical to those found in Big Five's *Super Nova* program. This makes it easy for those of us who have become accustomed to those controls.

By using an amplifier connected through the cassette port, you will be treated to sound effects. Using sound effects is the only way to really know how much shield power you have left. Each time your ship is struck while you are using the shields, you lose power. By listening to the sound when you engage the shields, you can tell how many more collisions your ship can survive. At every 10,000 points you are awarded a new ship.

Since *Bounceoids* does not increase significantly in difficulty once you reach skill level nine, it is theoretically possible to play forever, as long as you keep winning new ships.

Bounceoid boulders do not break into smaller pieces when shot; but it takes four hits to eliminate one. There are also Tiny Bounceoids Clusters in which many, many rocks all occupy the same space and follow the same path. These can become quite confusing, not to mention difficult to destroy.

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21. What leading software publisher has changed it's name, and why?

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Why change your name when you're a leader in the industry? Why change the symbol of a proven winner? The reason is time. As times change, so must leaders if they're to remain on top. We set TODAY'S industry standards and we'll set the standards for TOMORROW. We develop software specifically tailored for the user, whether they are at home, the office or in school. When you find the answer, remember it — you've found a WINNER!

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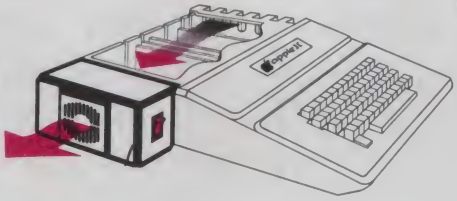

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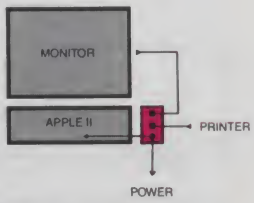

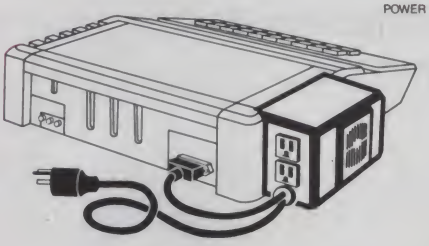

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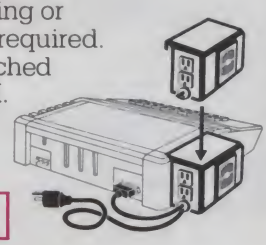

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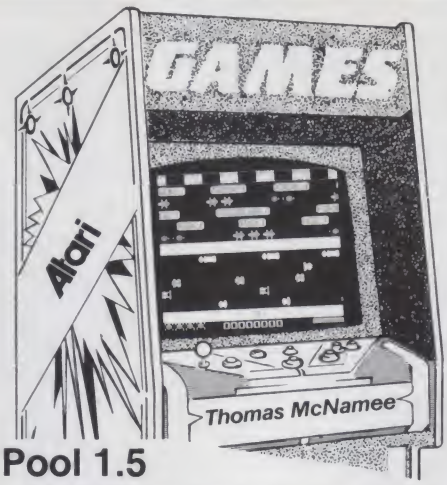
In addition to all this, there is a special creature that when hit, breaks up into four space stations. Each station goes on one of the four edges of the screen and then follows your every move, occasionally shooting at you. These guys get to be a real pain in the asteroid.

Another thing *Bounceoids* has, that Asteroids doesn't, is Challenge Stages. At every 20,000 points you are treated to one of these showdowns. A string of aliens come on-screen and proceed to swirl around in strange flight paterns. These creatures can't kill you, but they sure provide good target practice for you. There are many different challenge stages and unless you are *very* good, you will not see them all. This variety gives you an incentive to keep on trying just to see what will happen next—a feature that many games lack.

I recommend *Bounceoids*, it's fun, it's different, it's good. What more can I say? *Bounceoids* is a well written arcade game. It is a good example of how a clever programmer can take a rather bland game concept like Asteroids, and turn it into a great new game in its own right. If you are sick of all the different maze type games, *Bounceoids* offers a refreshing change. Give it a try, you'll be coming back for more.



Pool 1.5

My initial reaction to the idea of pool on a computer was that it would be awfully hard to do well. Pool, I thought, would be too much of a physical game to run on a micro. IDSI has proven me wrong with the release of *Pool 1.5* for the Atari.

The first nice feature that *Pool 1.5* provides was revealed to me when I left my Basic cartridge in the computer and tried to load the program. A message appeared on the screen saying REMOVE CARTRIDGE. That was a refreshing change from BOOT ERROR. After removing Basic, the program loaded quickly.

creative computing
SOFTWARE PROFILE

Name: Pool 1.5
Type: Billiard simulation
System: Atari 48K
Format: Disk
Language: Machine
Summary: Excellent high resolution, real time simulation
Price: $34.95
Manufacturer:
IDSI
P.O. Box 1658
Las Cruces, NM 88004

The first screen shows the pool table and a prompt for the number of players (1-4). There is also a Demo mode which demonstrates the action of the balls during play. The computer does not play pool with people, but all of the four games can be played alone.

The players then enter their names, and decide which game is to be played. The game keeps track of whose turn it is by name and, in 8-Ball, will tell you who has solids and who has stripes. You can choose from Straight Pool, 8-Ball, Rotation or 9-Ball. The rules of each game are

23. What's the reward for seeing a female frog home in

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24. What kind of refreshments does mother give out in

THRESHOLD

The aliens keep attacking, wave after wave, but even the best arcade gamer needs a break once in awhile. A visit to mother will give you a breather, but you'll also get something else. What it is — we won't tell!
How many waves of aliens are there? Although the game was introduced on the APPLE almost a year ago, many of the most avid players of this game still haven't seen the last of the vast array of aliens that THRESHOLD has to offer. Give them time though, they won't quit playing until they can!
Threshold is an arcade game offering over twenty waves (how many more we won't tell) of aliens attackers brought to life with quick animation and colorful Hi-Res Graphics. Available for $39.95 at your local computer store or order directly from SIERRA ON-LINE

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kept simple to allow for individual variations in play.

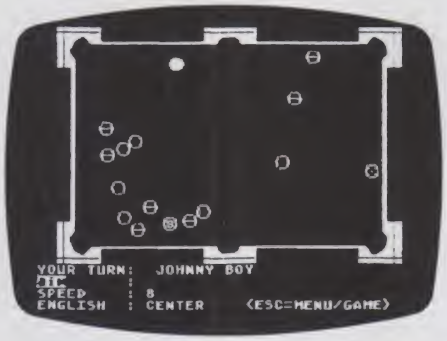
The only difference I found in the rules was in 9-Ball. The program returns the 9 ball to the table when it is sunk out of turn. When I play Uncle John in southern Maryland, the rule is that sinking the 9 ball using a proper combination is the end of the game. I have lost many quarters to Uncle John because of that rule, so I remember it well. The play of the other three games is pretty much the way I was taught.

The game is played with either the keyboard or the paddle controllers. The cue ball appears as a white ball on a red surface with a dotted line extending from it to a "ghost" ball which represents the point of impact for the cue. Rotating the paddle moves the ghost ball and provides coarse aiming at 128 different locations around the cue. Pressing the A key at this point allows fine aiming at a resolution of 32 positions to either side of the selected coarse position.

Aiming is only one of three parameters to be chosen, however. Pressing the space bar will bring you to the speed selection, where a 1 is a light tap and an 8 is an extremely hard shot. Pressing the space bar again switches down to the english selection. Using the paddle, you choose from top, bottom, center, left or right and combinations thereof. Pressing the paddle fire button shoots the ball. This can be done at any time, with the speed and english defaulting to your last selections.

When the shot is off, the realism begins. The balls make a pleasant clicking sound as they hit each other, and a sunk ball makes kind of a gulping noise, as if it had been eaten. The physics of collision have been reproduced very well, and shots must be aimed and hit properly. In the case of a scratch, the cue is returned for positioning. The program questions the user if any balls sunk during the scratch are to be returned, allowing for individual tailoring of the rules.

There are several key-selected features in Pool 1.5. A favorite of mine is the Repeat Shot. Pressing the R key will restore the table to its last condition and allow you to change the angle or speed or english and try again. In several games with one of my cats, I've found this feature great for cheating. He doesn't know the difference.



The balls appear either as stripes and solids, or with their numbers showing. The C (color) key allows the user to choose between these two options. The ESC key toggles between the game table and the menu/scoreboard. The scores for all players are kept here, and is updated each game so that a tournament of many games is possible. Other user-controlled functions include setting the table friction and the motion or speed at which the balls interact.

The keyboard commands are a little tough to master, and setting up a shot can require quite a few keystrokes. It takes several trips between the paddles and the keyboard before you can shoot. Although the high resolution part of the hi-res graphics is excellent, I find the uniform background and table color of red to be unattractive. Perhaps a later release of *Pool 1.5* will include a set-up feature to permit trick shots. But overall, the reproduction of the game of pool is accurate and fun. It is a relaxing and enjoyable game.

25. What does a

LUNAR LEEPER

like to eat for lunch?

Well, it's not a sandwich, but it could be a manwich. They usually want something more substantial for lunch, though. It's your job to make sure they stay hungry, but this makes them hopping mad! Lunar Leepers can eat you out of house and home, though they prefer you between two slices of bread. Their eyesight is sharper than yours or mine, but their vision isn't 20/20. To see what we mean, play the fast-moving LUNAR LEEPERS. Available at your local computer store for $29.95 or order directly from SIERRA ON-LINE.

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26. What two things do the mice in

Mouskattack

like to eat most?

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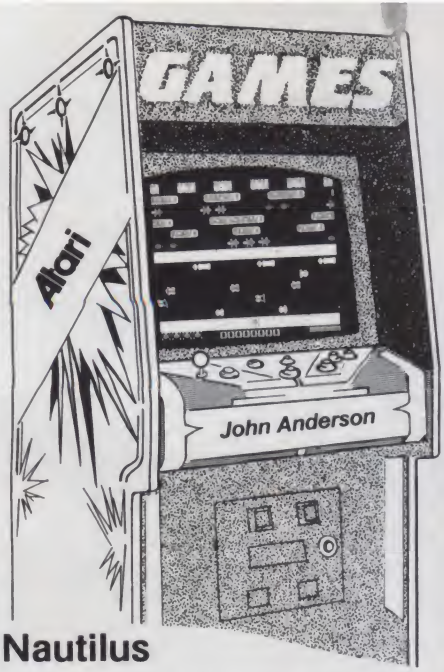

Nautilus

Mike Potter has done it again—this time in the guise of Captain Nemo. So much goes on in *Nautilus* it's hard to know just where to begin.

If you are familiar with *Protector* you will be reminded of it when playing *Nautilus*. Many facets of game play are similar, including a scrolling "microworld" several screens wide, and cities of steel and glass. Potter has developed an imaginative, storytelling style, and it is gaining in scope.

There are two independently scrolling screens in *Nautilus*. The top screen maps the progress of Colossus, the destroyer that constantly ferries repair teams across the microworld sea. It is armed with depth charges and heat seeking missiles, and can move at high speed. Among other dangers, the captain of the Colossus must remain wary of helicopter air attack.

The bottom screen maps the position of Nautilus, the malicious, energy-starved submarine. The Nautilus is armed with unlimited torpedoes, which are very handy—for the sea is filled with dangers. Besides the depth charges and smart missiles dispatched from Colossus, the deep is populated by limpet lurkers, dastardly and unrelenting smart mines. They lock on the course of the Nautilus, and maintain pursuit. It takes up to five direct torpedo hits to put one out of commision.

The goal of play for the commander of the *Nautilus* is to destroy underwater cities. In the cores of these cities reside the proto-pods which must be captured to replenish the voracious batteries of the sub.

Meanwhile, upstairs, the Colossus transports underwater repair crews to the rescue. On its way, it positions itself over the Nautilus, and unleashes a deadly mix of missiles and depth charges. It continues then to the western shore to drop off its crew. The crew will work its way eastward, repairing destroyed cities as it does. If the Nautilus remains in proximity to a city under repair, it will be destroyed. It therefore becomes a priority to keep the Colossus from ever reaching the western shore.

The captain orders Nautilus to the surface, and steers it into shallows where there are no smart mines. Here it lies in

creative computing
SOFTWARE PROFILE

Name: Nautilus

Type: Arcade/strategy wargame

System: Atari 400/800 32K

Format: Cassette/disk

Language: Machine

Summary: Unique and engrossing action game

Price: $29.95

Manufacturer:
Synapse Software
820 Coventry Rd.
Kensington, CA 94707

27. What is the secret password to begin

MISSION ASTEROID

Get the password — or become a victim of it. Your password will constantly remind you of your mission — a race against time to save the Earth. Better hurry though, the sky is beginning to fall! Available at your local computer store for $19.95 or order directly from SIERRA ON-LINE.

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28. What password is hidden on the restroom wall in the adult text adventure

SOFTPORN ADVENTURE

Read the handwriting on the wall and set out for your ultimate fantasies in the gambling capital of "Lost Vague-ness". You didn't bring much spending money, but maybe lady luck will shine your way when you visit the addicting casinos. Be forewarned though, being too immoral can result in death, purgatory, or ? SOFTPORN is available at your local computer store for $29.95 or order diretly from SIERRA ON-LINE.
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ambush, in hopes of damaging Colossus enough to force it back to the eastern port.

The dual screen approach is unique, and allows the positions of both ships to be depicted simultaneously, even though they may be as many as five screens removed from one another. Sonar aboard each ship indicates the relative position of the other. When their screen locations coincide, the command console flashes red.

The ships can repair themselves as many times as necessary, but repairs cost precious time. The Nautilus must be careful not to so much as graze any solid surface—she goes down if she does. This makes navigation of the many underwater caverns a tricky business.

Nautilus can be played by two players, one at the helm of the Colossus, the other of Nautilus, or as a solitaire game, with the computer controlling the destroyer. Length of the game is selectable from three to nine minutes. There are nine skill levels, as well as the option to energize energy core transformers, gates throughout the sea, making the game extremely hazardous. This mode is not for beginners.There is a handicapping option as well.

Nautilus is a tour de force. The opening music is excellent, and hints at a context for the game—the tune is "Volga Boatmen."

The really appealing thing about the game, as in its predecessor *Protector*, is the creation of a microworld; in this case an undersea world, full of secret grottos and hidden dangers. The fine-scrolling graphics capabilities of the Atari are used to their fullest potential. *Nautilus* is another must from Synapse Software.

I do have a complaint, and though it is a small one, it is persistent. Allow me to appeal not only to Mr. Potter, but to *all* game designers with this plea: *please include a pause feature in your games*! Do it with the space bar, the escape key, CONTROL-1, SELECT; I don't care how, but please do it. It should be noted that the lack of such a feature becomes evident not only when the phone rings, but when it comes time for us to take pictures of a program for inclusion in a review such as this one.

Pause or no pause, *Nautilus* is addictive and a lot of fun. I recommend it very highly.

Shamus

In the August 1982 issue, I wrote about the burgeoning "arcade adventure" format for Atari games. I spoke specifically about *Action Quest*, a brutally tough but very compelling hybrid adventure, calling for hand-eye dexterity as well as adventure skills.

Shamus, also from Synapse Software, takes another stride in the development of the arcade adventure. Make sure you have no pressing appointments before becoming involved in a round of *Shamus*. Once you get going, you won't want to stop for a while.

The humorous feeling surrounding the game provides much of its appeal. Author William Mataga first sets the mood, with a grand rendition of the theme from the

29. Which top Apple Software Publishing company uses

the Artist

to create its

amazing graphics and animation?

(We'll give you a little hint on this one.)
The graphics and animation routines used in Mouskattack, Threshold, Crossfire and Time Zone were created by The ARTIST, and you'll find this package in use by such noted programmers as Warren Schwader, Rob Davis and Ken Williams. QUESTION: Which publishing house employs these programmers, and why do they all use The ARTIST?
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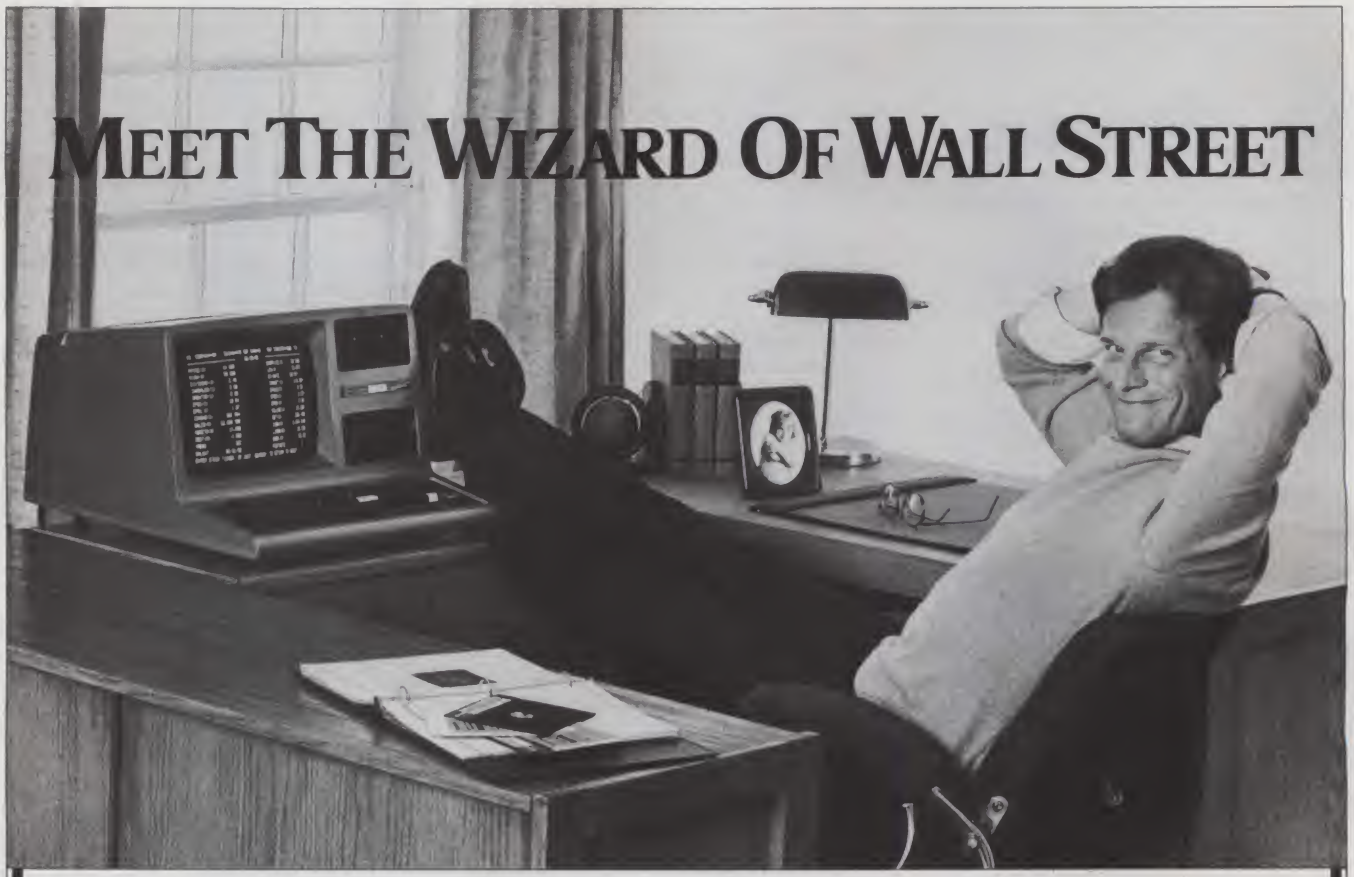

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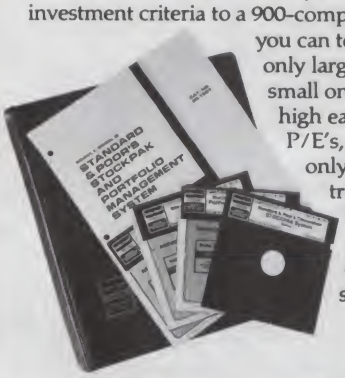

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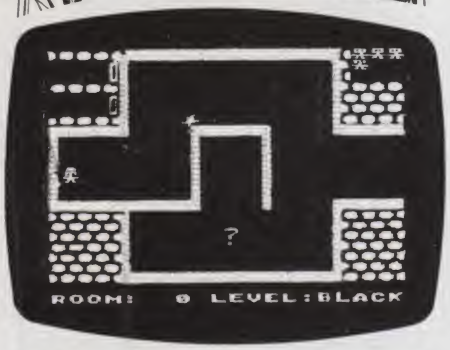
CIRCLE 335 ON READER SERVICE CARD



old Alfred Hitchcock show. The player is then thrust into a complex maze of 32 rooms, containing some very diabolical nemeses. As Shamus, the player must penetrate four levels of 32 rooms each, to finally destroy the Shadow in the heart of his lair.

Don't hold your breath waiting for the completion of this goal. It is bound to take you at least a month. You see, populating each room are the Shadow's henchmen: Whirling Drones, Robo-Droids, and Snap Jumpers. The sole pleasure in their lives is to keep you from getting near their leader. And they do a job of it. You are armed with Ion Shivs, and as your opponents are always prepared to fight to the death, the action is necessarily violent.

For those of you who have always wanted to wear a fedora as a character in an Atari game, this is your chance. The rakish lid is your most dashing feature. I'm not sure, but I think my hat has been shot through by more than one Robo-Droid blast. Take that, sweetheart...

creative computing
SOFTWARE PROFILE

Name: Shamus

Type: Arcade adventure

System: Atari 400/800 16K

Format: Cassette/disk

Language: Machine

Summary: Another stride in "arcade adventuring"

Price: $29.95

Manufacturer:
Synapse Software
820 Coventry Rd.
Kensington, CA 94707

Once in a while during your search you will encounter a pulsating question mark, the function of which is similar to "Chance" in Monopoly. By touching the punctuation mark you invite extra points and extra lives or ill fortune. I have found it hard to resist them in the long run.

To advance to a higher level, you must obtain the correct keys and unlock the correct portals. This calls not only for keen aim of your weapon, but knowledge of the labyrinthian layout of each maze. Secret passages abound, and it is quite easy to get lost. The bottom of the screen reads out a corresponding number for each room, and this is the only hint you get. I always seem to disorient myself right after unlocking a portal.

Your natural tendency is to shower attackers with ion fire. After a few games, however, you discover that fewer but better aimed shots will nearly always be a superior strategy. Keep cool, and if you find any bubbling flasks lying around, drain them: they will give you new life.

You will notice a couple of familiar tunes recurring throughout the game: one is from the old "Dragnet" series, and the other, if I remember correctly, is from "Get Smart."

Shamus is a very addictive detective game. It will remain in the front of your game software collection for some time, I guarantee it. Arcade adventuring is an emergent and promising gaming category, and this program underscores that fact. □

31. What word describes our best-selling adventure series?

?

With our help, adventurers throughout the world have experienced space and time travel, classical mythology, murder, mystery and magic!
From fantasy role-playing and Hi-Res color graphics, to the largest of all existing adventure games, Sierra On-Line has consistently created "FIRSTS" in the industry.
We were the FIRST to successfully have an adventure game remain in Softalk's TOP THIRTY for over a year.
We were the FIRST to create the largest Hi-Res adventure game for any microcomputer.
Now, what word describes Sierra On-Line's best-selling adventure series? Our very name will give you a clue . . .

Sierra ON-LINE INC

36575 MUDGE RANCH ROAD COARSEGOLD, CA 93614
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32. What name illustrates the best-selling arcade line from Sierra On-Line Inc.?

?

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A microprocessor in every component of this price-is-no-object stereo hi-fi system.

creative computing equipment evaluation

Bang & Olufsen Beosystem 8000

David H. Ahl

In the past, a few readers have taken me to task for doing reviews of hi-fi equipment. "After all," said one reader good-naturedly, "what credentials do you have to do hi-fi reviews?"

He was right. Although my fifth year EE project at Cornell was in acoustics and I worked briefly for Alcor, an innovative speaker manufacturer in the late 50s, this hardly qualifies me as an expert reviewer of hi-fi equipment.

On the other hand, I believe I am a rather discerning listener and user. I regularly attend symphony concerts at Lincoln Center and Symphony Hall in Newark, and outdoor concerts at Waterloo Village, Delaware Water Gap, and other locations. In addition, when travelling, I always make an attempt to attend local performances of interest. For example, last week in Washington I heard the U.S. Marine Band perform at the Jefferson Memorial.

Hence, in evaluating a hi-fi component or system I look for three things: 1) realistic sound reproduction, i.e., how does the sound compare with the original? 2) User friendliness, i.e., ease of installation and use. 3) Innovative technology. Obviously, my main interest is to see the various ways in which microcomputers and microprocessors are being used to advantage in other consumer products.

Obviously, we can't afford a great amount of space for this sort of thing in *Creative Computing*. After all, if you want hi-fi reviews, you should be reading *Stereo Review*. However, from time to time we will try to review innovative products of excellence on these pages. Hence, it was with more than passing interest that I read the letter from Fran Dym of Bang & Olufsen's public relations agency. Fran had seen my reviews of the dbx 20/20 Equalizer, KLH computer controlled speakers, Advent Sound Space control, etc., and wondered if I would be interested in reviewing the Bang & Olufsen Beocord 9000 cassette recorder. I was excited at the possibility but found it hard to imagine reviewing a component that cost nearly as much as the rest of my system combined. I called Fran and told her that, to which she replied, "Why don't we send you the entire system?"

Good Grief! This was an offer I couldn't possibly refuse.

I had seen and heard the Bang & Olufsen Computer Controlled Beosystem 8000 at the last Consumer Electronics Show and was most impressed by its performance. Here, however, was the opportunity to try it in a more realistic listening environment as well as get the reaction of other people to the system.

In due time three massive cartons arrived—no stereo compact this. The receiver and cassette deck are about one-third again larger than other "standard size" stereo components. The turntable is about the same size. The components are connected to one another by means of DIN plugs on shielded cables supplied with the system. For those using just one component with other standard components, cables with RCA-type phonojacks are provided.

Initially, the instruction manuals appeared as formidable as the many controls on the components. The manual for the overall system runs 54 pages while the manuals for individual components run between 8 and 26 pages. Each component also includes a complete wiring diagram and a bright red booklet, "Safety Instructions," which deals with such things as ventilation, heat, antenna grounding, and the like.

Beosystem 8000 as pictured in Bang & Olufsen press release photo.

Beosystem 8000 as initially set up in my living room for this evaluation.

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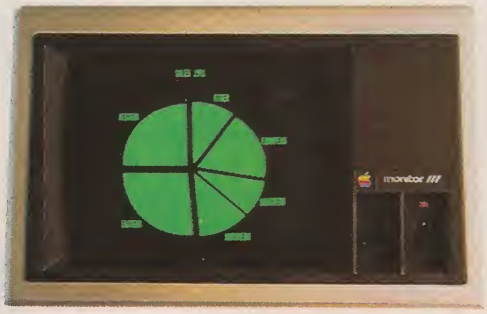

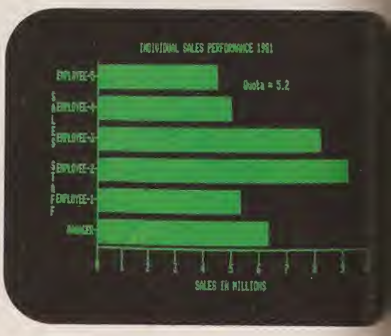

	Apple	VisiTrend/ VisiPlot	pfsGraph
Graph Types			
Line	Yes	Yes	Yes
Vertical Bar	Yes	Yes	Yes
Horizontal Bar	Yes	No	No
Side-by-side Bar	Up to 4	2	4
Pie	Yes	Yes	Yes
Partial Pie	Yes	No	No
Scattergram	Yes	Yes	No
Curve Fitting	5 Kinds	1	None
Data Points (Max.)	3500+	645	36
Plotter Compatible	Virtually Any	None	H-P7470A Only
Compatible File Types	Pascal BASIC VisiCalc	BASIC VisiCalc	pfs VisiCalc
Math Functions	Yes	Yes	No
Available Colors	6	4	4

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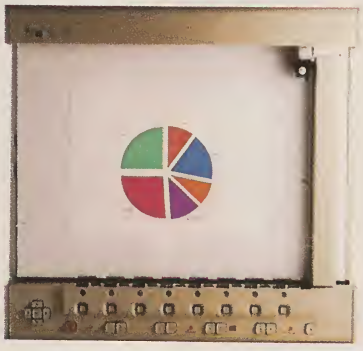

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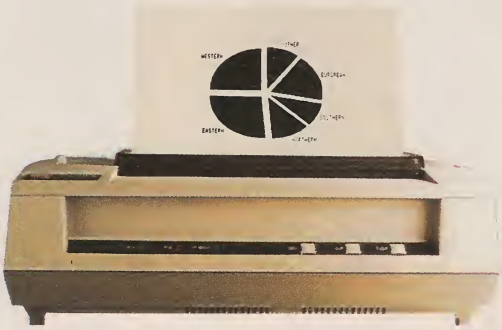
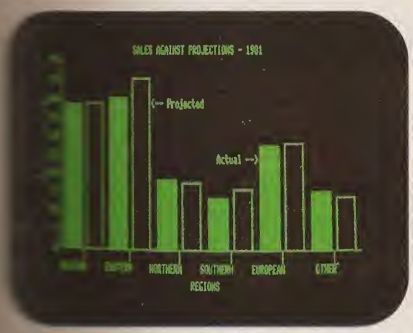
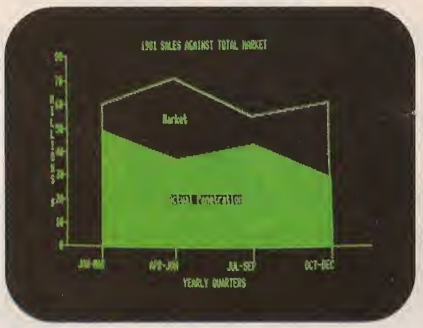
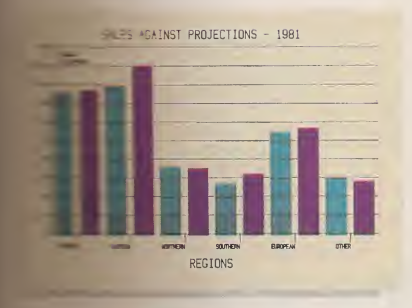
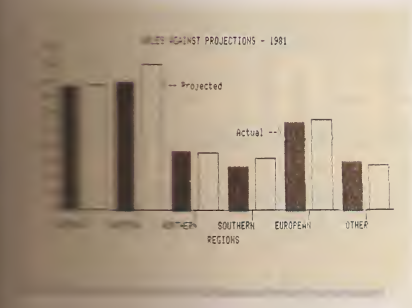


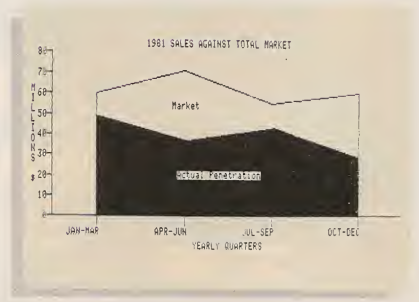
graphics are alike. pictures to prove it.











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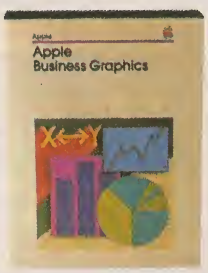

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Beomaster 8000 Receiver

The heart of the Beosystem 8000 is the Beomaster 8000 receiver. The Beomaster has plenty of power—100 watts per channel with 8-ohm speakers or 150 watts with 4-ohm speakers. Although volume levels of 20 watts are more than enough to drive the average listener from his living room, the additional power is important because of distortion. Music, particularly classical music, contains a broad spectrum of frequencies and a wide dynamic range. To reproduce the full scope of this sonic information accurately, especially at high volume levels, requires an amplifier with generous and stable power. When this power is lacking, clipping distortion occurs.

Even when this distortion is not particularly audible, it limits the dynamic response of the music, weakening the recreation of the original performance. For the normal home listening environment, or even a small auditorium, the Beomaster 8000 provides plenty of power to virtually eliminate clipping distortion.

However, it is in the tuner section where Bang & Olufsen's expertise really shines. The tuner features what is known as "digital frequency synthesizer construction." That long description means that FM tuning is accomplished with the aid of an internally generated reference frequency created by the vibration of a quartz crystal.

This frequency synthesis is then united with an innovative system of error-free automatic fine tuning. When the control is activated, the tuner will automatically lock on to the actual transmitted frequency of the FM station. This means that regardless of the drift of frequency or unstable reception conditions, the tuner will continue to follow the actual transmitted frequency with high accuracy.

The Beomaster 8000 receiver has two control sections: primary and secondary. The primary controls are located on the right front panel and, in most cases, are all that one would need for operating the system. The secondary controls are located beneath a brushed aluminum cover on the left rear of the system which raises upon pressing the word "programming." Also under this panel is a hinged access panel which conceals the input and output connectors for the receiver. For connecting to other B & O components, special 7-pin DIN sockets and cord sets are used. These carry the input signals as well as allowing communication between the microcomputer of the Beomaster with that of the turntable and cassette deck.

The expected two sockets are provided for an FM antenna: one for an antenna with 240-300 ohm impedance (included) and a coax input for an antenna with 60-

75 ohms impedance. Unfortunately, neither connector conforms to U.S. standards and if you elect to use the 75-ohm coax imput, as I did, you are in for some trouble. Although the socket looks like a male F connector (U.S. receivers would provide a female F connector) in reality it is slightly smaller than an F connector and no amount of cussing will make it fit.

B & O furnishes a female connector for the FM input which connects directly to coax cable. It was not at all obvious how the cable shield was supposed to be attached nor was this mentioned in the instructions. Presumably if you get a B & O system, these are things the dealer will handle.

The speaker connectors are tricky little buggers which must be permanently attached to the end of your speaker cables.

The primary controls consist of 13 buttons and 2 wheels. All are set flush into the surface of the receiver. The free-turning wheel on the left controls volume. It can be adjusted over a range 60 increments of 1.5 dB each. An LED digital display shows the current volume setting. The display is on the right of the receiver above the control section behind dark plexiglass.

A companion control to volume, but in the secondary control area, is balance. After you have adjusted volume and balance to a preferred level, you can then press the "store" button and these levels will be stored in the memory of the microcomputer. Thereafter, each time your system is turned on it will return to the same volume and balance settings.

The twelve touch buttons in the center of the primary control panel are for selection of inputs. One selects phono, two select tape, and the other nine select nine preset FM frequencies from the tuner section.

The large tuning wheel on the right side of the control panel is used to tune FM stations. The frequency being received is shown in a large LED display above the tuning wheel. A station may be preset by simply tuning to the right station, pressing "FM Store" in the programming section and pressing one of the buttons, P1-P9.

The last button in the primary control section is used for turning the receiver off. To turn it on, you simply press the input selection that you desire.

The receiver also has the expected bass sation switch, stereo/mono switch, high pass filters, tape monitor switch, and tuning mute switch. Putting some of these into service lights an appropriate indicator in the display section.

One switch, found on few other systems, allows the FM signal strength meter to show the strength of a multi-path signal. In other words, this could indicate that your FM transmission is being affected by reflected signals from high buildings, a hillside, or other barriers. To minimize the distortion caused by such reflections, you can adjust your FM antenna using this meter as a guide.

Another rarely found indicator in the display section lights up if the volume is increased to such levels that clipping distortion will occur at peaks in the music. This does not indicate that any damage is being done (except, perhaps to your ears) but that clipping distortion is occurring.

A phone jack (standard) is provided on the front of the unit for stereo headphones. In addition, a pair of RCA phone jacks are available on the left side for connecting other audio components such as an equalizer, expandor, or the like. I did not try this with my KLH computer-controlled speakers although the combination should work.

Although a tuner, cassette deck, and turntable are the most common input devices for a hi-fi system, I was disappointed that the designers did not provide for any addtional input devices, such as a laser disc player, computer synthesizer, or component TV system. I feel that a receiver that is obviously designed with years of service in mind ought to anticipate that more electronic audio devices are coming down the road.

I was also surprised to find no additional auxillary power outlets on the receiver. Unfortunately, this system requires a separate wall outlet or equivalent for each component.

Beocord 9000 Cassette Recorder

The Beocord 9000 is by far and away the most sophisticated hi-fi component which I have ever touched. The performance is nearly unbelievable, but let me take you on a guided tour of the deck and its controls before getting to that.

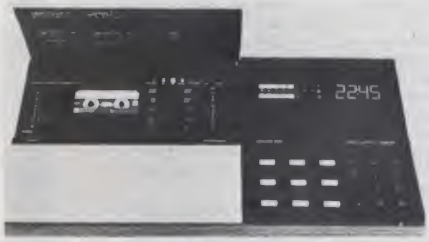
Upon turning on the deck, the first

thing you notice is a large digital LED display (normally invisible behind black smoked plexiglass). Unlike those impossible mechanical counters found on most other tape decks, the digital display always shows the elapsed minutes and seconds of tape travel regardless of operating mode (playback, record, fast forward or rewind). I found it especially convenient to work with a system in real time rather than trying to guess how much tape was left or use a not-very-accurate watch like I have done so many times in the past. This feature alone may justify the cost of the deck.

In a sense, all the controls of the deck revolve around the timer. When you place a cassette in the Beocord and press Play or Record, the deck will automatically assign the time 00:00 to the starting point of the tape (by using the fast forward or reverse controls, you can shift the starting point if you wish). From then on all times on the cassette are shown relative to this starting point.

To calibrate any cassette, say a previously recorded one, to a real time index, you simply press the "Go" button on the control panel. The following operations then take place. The tape will rewind to the beginning, it will be advanced for approximately 12 seconds at playback speed while it is analyzed by the Beocord microprocessor. Then, at fast forward speed it will be advanced once again, shifted to playback speed and calibrated for an additional six seconds.

Once the calibration process is complete, the tape will automatically return to the location at which it was loaded when the cassette was inserted. Playback will then begin.



If you want playback to begin at a location well into the tape, say 10:25, you simply press 1025 on the front panel and then press Go. The tape will advance to that point and start playing.

I mentioned earlier that pressing "Go" will cause the Beocord to "analyze" the tape. What does this mean? The microprocessor runs through a short measurement process which takes into consideration all the physical characteristics of your cassette. A small data bank on this cassette is then created in the computer memory and a real time calibration takes place. Calibration is unique to each

External control panel.

cassette and takes into account varying tape types (iron oxide, chrome, metal, etc.) and the thickness of the magnetic coating. Thus each time you insert a cassette the process begins again.

Another pair of control functions, for which I admit I found no practical use, is "Memory Set" and "Memory Go." In playback, pressing Memory Set on the control panel will place the present tape position in the Beocord memory. To return to that position at any time you simply press "Memory Go" and the Beocord will fast forward or rewind to that location and begin playback.

Much more useful was the "Return" button. Unlike Rewind which brings you to the beginning of the tape, Return causes the tape to rewind to the beginning of the last recorded segment. Thus, if you are recording from the record and get an annoying bit of static on one band, you need not return to the beginning of the side and start over. Rather, you can simply return to the beginning of the last selection. (This doesn't always work, since the Beocord is looking for four seconds or more of silence before it will stop.)

Where the deck really shines is in recording. To start a recording, you place your cassette in the deck and press "REC OPEN" in the programming section. This activates the recording circuitry and illuminates the corresponding indicator.

You then press "REC CAL." This initiates the tape calibration process. This takes approximately nine seconds during which time the Beocord will optimize its recording circuitry in relation to the bias, equalization, and sensitivity characteristics to the tape you are using. Also, an analysis of your tape distortion is made, and the electronic peak program meters

Internal control panel.

are automatically calibrated to reflect the recording ability of your specific tape.

If you wish, you can store the calibration date of up to four tape types in the Beocord memory. This means that if you use the same brand and type of tape, you do not have to use the "REC CAL" process each time you insert a new cassette.

In the record mode, the timer will tell you not only how much time has elapsed since the beginning of the tape, but also how much time remains on the cassette you are using. No matter whether you are using the elapsed time or time remaining display, a "Tape End" warning will flash approximately five minutes before the end of your tape. It will continue to slowly flash until the end of the tape.

For those who like to know what's going on inside the recorder, the Beocord allows you to display some of the calibration data on the display panel. For example, you can look at the bias on the right and left channel, equalizing, sensitivity, and distortion level. I had fun finding out that TDK tape had a lower distortion level than Audio Magnetic which, in turn, was lower than DAK tape, which, in turn, was lower than Realistic (Radio Shack) Low Noise Tape. In fact, I had one old unbranded cassette that had calibration data so far removed from the standards that the Beocord refused to accept the data in memory.

The Beocord has an 8-level peak program meter (signal strength). This provides real time measurement of the input signal strength for both left and right channels. As with most recorders, you adjust the signal so that it is mostly in the green and the loudest peaks light up the first red indicator. However, the Dolby C and HX Professional circuitry allow recording a much wider dynamic range than most other recorders are capable. The HX circuit automatically delivers a constant, signal controlled bias current to the record head regardless of the varying signal strength or frequency content. This constant bias current means that every tape type gains in signal handling and capacity without increased distortion. This was originally developed by Bang & Olufsen and is now being licensed to other manufacturers by Dolby Laboratories. Basically, the signal is evaluated after all processing (noise reduction and equalization) so the adjustment is made on the basis of what is actually going on to the tape. The constant bias means that both high level high frequency signals as well as very low level signals will all go on to the tape at the same level of tape saturation. This minimizes saturation and even self-erasure. This explanation may sound like gobble-de-gook, but the sound on the tape is unbelievable. I recorded several 45 rpm digital records and could scarcely tell the difference on playback between

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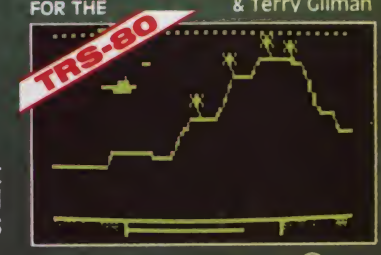

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the original sound source and the tape, even on the relatively low quality Realistic tape. A listener with better hearing than I commented that the Realistic tape did not have the highs of the original recording but there was no audible difference with TDK and Maxell tapes.

These days, most high quality recorders have two or three heads. Earlier Bang & Olufsen recorders did. However, in the interest of maintaining optimum head alignment, the 8000 and 9000 series recorders went back to a single head. The owners manual spends three pages in describing the rationale for this decision. The ultimate test, of course, is in listening and in this regard I judge that it is considerably better than my current Brand X recorder with three heads. If I want written proof, I can simply go to the computer alignment paper tape which came with the recorder showing that it has + 1 db response from 20 Hertz to about 15K Hertz.

Rounding out the nifty features with the timer is the ability to set the time of day and a "Timer Start" and "Timer Stop" for making off the air recordings. These instructions are automatically communicated back to the Beomaster Receiver and the cassette deck is turned on and off automatically. If you wish to record, the receiver must already be on, however, if you wish to play back the deck will turn on the entire system. Thus, you could use it as a clock radio and wake up to a favorite tape.

I found that it took me some time to get used to the controls on the Beocord as they were quite different from a standard recorder. Initially, I was annoyed at not being able to monitor my recordings directly as I could with my existing deck. In some sense, I found the controls overly complicated for doing the "simplest" functions. On the other hand, once I got used to the "intelligence" of the deck coupled with the real time clock, I found it very much to my liking.

Beogram 8000 Turntable

Two innovations combine to make the Beogram 8000 one of the best, if not the best, turntable on the market today.

The first innovation is called "Tangengial Drive." A coil with a high number of windings is mounted outside of the circular aluminum plate which supports the turntable platter. When an electric current is passed through this coil, it produces a magnetic field. The stronger the current, the stronger the magnetic field. The aluminum plate next to this coil permits the magnetic field to pass through. However, the magnetic field within the aluminum plate does not decline correspondingly and an eddy current (also called a Foucault current) is induced.

Now if a similar coil with fewer windings is placed on the other side of the aluminum plate and a current is passed through, a weaker magnetic field is created. If the currents are kept in balance, a constant magnetic field will be maintained. Because the eddy current remains constant, the aluminum plate experiences a force that causes it to move. In this way, the turntable platter is caused to rotate with exceptional stability and reliability. In effect, driving the turntable is an electronic flywheel; there is no motor in the conventional sense. And because there is no conventional motor, there is no vibration, motor noise, motor hum, mechanical connections and resonances.

This system is coupled with a microcomputer programmed to continually compare two pieces of information: an unvarying frequency generated by a quartz crystal and the frequency created by the revolutions of the platter. The computer compares both signals and if there are deviations or phase differences it instantly sends instructions to the drive system and the speed is corrected. Because the revolutions of the platter itself serve as a reference for the correct speed, adjustment remains unaffected by changing line voltage and the turntable does not have to be adjusted with the exotic strobe lights or markings on a conventional system.

The second innovation is a lateral tone arm coupled with a cantilever cartridge. The extremely low mass, lateral tone arm is precisely perpendicular to the grooves in the record just as the original cutting head. Thus, tracking distortion is completely eliminated. However, in addition, the diamond stylus tip is mounted directly on the cantilever of the cartridge and not fitted with a bushing of any sort. This means the mass of the stylus assembly is held to a minimum which, in a practical sense, means low record wear. The cantilever of the cartridge is made of single crystal sapphire. Sapphire is an exceptionally rigid substance, some 500% stiffer than commonly used aluminum. Also, the speed of sound in the single crystal sapphire is twice that of aluminum which further reduces the possibility of phase distortion being introduced by the cantilever. Furthermore, the resonant frequency of single crystal sapphire is above the audible range so the entire assembly needs only minimal damping to achieve a flat frequency response.

Altogether, this leads to exceptionally flat response. Indeed, the computer data furnished with the cartridge indicates absolutely flat response from 20 Hertz to 18,000 Hertz on both channels.

Summing Up

In describing the Beosystem 8000, it is difficult to avoid the superlatives. Concert hall realism? Absolutely. Hum, hiss, and rumble? Virtually none. Off the air sensitivity and selectivity? Excellent. Visual appearance? Contemporary, refined and unobtrusive. Ease of use? Child's play on the receiver and turntable although it takes some getting used to for the cassette deck. Price? If you have to ask . . . (No, that's not fair, the receiver costs $2600, cassette deck $1800, and turntable $895.)

For that money, the minor glitches shouldn't be there. In particular, I would like to see provision for at least two more input sources in the receiver. I would also like to see U.S. standard connectors throughout (after all, the controls and displays are in English). And frankly, I would have expected a little more from the computer controlling the whole system. As it is, the computers handle the internal functions having to do with sound reproduction superbly. However, why shouldn't the control computer in the cassette deck be able to turn on the receiver to a particular station at a certain hour. Much more complicated control capabilities are built in to even the lowest cost video tape recorders (recording eight programs over fourteen days, etc). Even a $49.95 BSR timer unit controls up to 12 devices, each with their own on/off cycle. I would expect that level of control from an $1800 tape deck.

Nevertheless, for music reproduction the Bang & Olufsen Beosystem 8000 is superb. If you are yearning for a system with technical sophistication, outstanding design and the highest quality, and price is no object, this may well be the system for you. □

Digital Duo

creative computing
SOFTWARE PROFILE

Name: Electric Duet
Type: Music synthesizer
Author: Paul Lutus
System: 32K Apple, Disk Drive
Format: Disk
Language: Machine Language
Summary: Two-voiced music synthesizer all in software
Price: $29.95
Manufacturer:

InSoft
175 Barbur Blvd., Suite 202B
Portland, OR 97219
503-244-4181

David Ahl

Electric Duet is a music synthesizer software package for the Apple that plays two-part music without an add-on circuit board. While it can use the built-in Apple speaker, far better sound quality can be obtained *either* by using an external speaker in place of the internal Apple speaker or by using an external amplifier and speaker. To do this, the Apple cassette tape output jack (mini-phone plug) must be connected to the input of an amplifier. Since the output is monaural, you must use either the monaural switch on your stereo amplifier or, if it does not have one, a "Y" connector cable so that the monaural output may be fed into both stereo channels.

The normal range of *Electric Duet* is five octaves; however, notes in the upper half of the fifth octave are not accurate, hence, the usable range is 4-1/2 octaves. In playing back, it is possible to use a voice transpose to get a low sixth octave for one of the two voices. Incidentally, the internal Apple speaker will not play these notes because they are too low.

Paul Lutus, author of the *Electric Duet* system, created an all-software music synthesizer in the following way: First, a high-frequency carrier frequency (14080 Hz) is created. Then, the percentage of time it is turned on is based on whether one or the other of the two musical note cycles is "on" at the moment. Paul calls this "duty cycle modulation," which effectively transmits voltage increments to the speaker or the amplifier. These increments are controlled by counters containing numbers between 8 and 256. For example, to get middle A (440 Hz) the carrier frequency of 14080 is divided by the pitch number for middle A of 32 giving 440. You can see from this brief description why high frequency notes begin to lose accuracy.

As a result of producing notes in this way, the tonal quality doesn't begin to compare to a hardware system such as the ALF or Mountain Computer boards. Furthermore, these boards produce between three and nine voices usually in stereo. On the other hand, the cost of *Electric Duet* is a fraction of the cost of a hardware system and the resulting sounds are excellent, particularly considering they are produced entirely by software.

Note Entry

Note entry with *Electric Duet* may be done in one of three ways. Perhaps the easiest is music entry with a simulated piano. Upon selecting this option, a combination display will appear, part text editor and part stylized piano. The piano at the top of the screen covers a range of three octaves. The starting octave may be selected in order to extend the range to five octaves. Each key has a letter or number on it and, to play a note, that letter or number is simply pressed. This note then automatically appears in column 1 (for voice 1). You may then move to column 2 (voice 2) and play the second note or you may move down the score playing the melody line and come back later to put in the accompaniment.

The manual tells us, "the normal way to use the piano for music entry is to select the part with the most or shortest-duration notes, play that, then switch to

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the other entry column and play the (relatively simple) accompaniment." For example, the following melody line represents the first eight notes of "Greensleeves":

R, 6, U, I, 0, I, U, T, E

If no note duration is specified, all notes will be automatically assigned a value of eight (eighth note) duration. Durations may be assigned either at the time of note entry or later on. A duration may be anything between 1 and 99, although normally only the values of 1 (whole note), 2 (half note), 4 (quarter note), 8 (eighth note), 16, 32, etc. would be used. Dotted notes, of course, would have duration values half way in between these.

Electric Duet has no provision to define measures. Rather, a part is entered as a continuous string of notes, thus requiring the user to keep accurate track of notes, rests, and the flow of a composition. Furthermore, corresponding notes in both parts must be of the same duration. In other words, it is not possible to hold a whole note in the accompaniment while four quarter notes play in the melody. Instead, the accompaniment must be four quarter notes.

Hence, you cannot simply copy sheet music into *Electric Duet*; it must be rewritten either on paper or in your head so that all notes in both parts are of the same duration. As a result of this rather severe limitation, *Electric Duet* is considerably more suitable for baroque and other types of music with fast-moving parts, than music with a melody line and a slow rhythm accompaniment.

A second method of entering music is to specify a note in the form:

2F
4A#
2G

reading respectively, an F in the second octave, an A sharp in the fourth octave, and a G in the second octave.

A third method of entering notes is simply to enter them as numbers. Remember that each note is created by a value divided into 14080. By entering these values, you may enter standard (or non-standard) notes of whatever pitch you wish. Needless to say, you can create some rather spectacular special effects using this technique. You can also create some extremely unpleasant sounds reminiscent of Schönberg or a cat whose tail has just been stepped on.

When a song has been entered and you have it to your liking, it may be saved onto the disk. We recommend doing this before moving on to some of the other interesting, but potentially destructive commands of *Electric Duet*.

Other Commands

One such command is Transpose. With it, you can speed up or slow down all or part of a musical file, change the key in which it is played, and do special kinds of editing.

Each entry to Transpose includes a starting line number (note number), and ending line number, a specifier telling Transpose which part of the entry to change (voice one or two or the duration of both voices), and a number telling how far to move or change. For example, the entry T/0/8/D1/2/ will halve the duration of notes 0-8. The command T/9/17/N1/-4/ would lower the pitch four semi-tones of the notes 9-17 in Voice 1.

The price puts a music synthesizer within the reach of virtually anyone.

Editing your composition is accomplished by treating it as a file, opening it and inserting or deleting desired material, and closing it again. It is not a particularly handy feature and, being forced to use it once or twice, convinced me that taking a little extra time and care on initial note entry was well justified.

A note trace feature, which plays each note as it is scrolled from the editor (as the piano feature does) is provided. This helps in debugging a composition which, because of careless note entry, didn't come out quite right. We wish that provision were available for printing notes on a Silentype or other Apple printer.

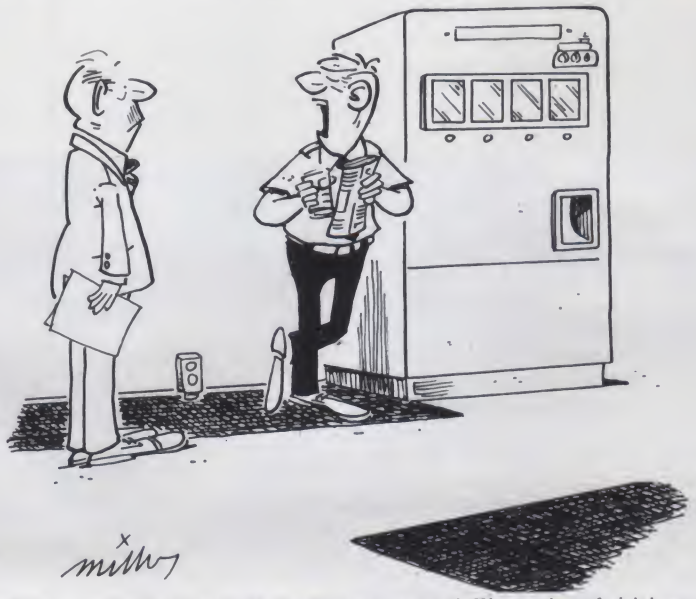
Electric Duet assumes we are living in an all electronic world and have no need for paper. So does every other music synthesis system, incidentally.

A wonderful feature of *Electric Duet* is the ability to load the playing routine in a basic program and call it from Basic. The playing routine is quite short, so it will not take up much space in your Basic program, yet the addition of music can enhance an otherwise ordinary Basic program enormously.

Although I've been spoiled by the marvelous entry, editing, sound, and visual playback features of the ALF Music System, I cannot help but be impressed with what Paul Lutus has accomplished with just the basic hardware of the Apple coupled with this amazing software package. On the negative side, I would have to downgrade *Electric Duet* for its inability to play notes of different duration simultaneously and for its awkward editing procedure. On the positive side, the price puts a music synthesizer within the reach of virtually anyone and it is the only system available that permits the easy addition of music in Basic and other programs. This alone is enough to recommend it.

On the disk that comes with *Electric Duet* are fourteen pre-programmed compositions, mostly by Bach. Using "Juke Box mode," these compositions can be played individually or the entire group sequentially. You can, of course, add your own compositions to this group or create your own Juke Box.

Electric Duet is rather effectively copy protected and, once booted cannot be exited except by turning off the computer. The disk provided is a two-sided disk with a backup copy of the program and music compositions on the second side. □



"We traded. Accounting got the 11/34, the 370 and the VAX. We got the soft drink machine."

Speech, Speech!

Gordon McComb

It wasn't long ago that hobbyists began giving their computers a say in matters. But voice synthesis has always been considered an expensive and time consuming proposition.

Times have changed.

Speech synthesis technology has come a long way since Radio Shack and others first offered their synthesizers to the public. These units, although advanced for their time, required programming sound by sound with an extensive and intricate word code. It took hours to input a few minutes of speech.

New models on the market, including Type 'n Talk by Votrax, Textalker/Echo from Street Electronics, and the Terminal Emulator II from Texas Instruments, enable the user to type in plain English for the synthesizer to duplicate. Text-to-speech voice synthesis has been around for a while, but only recently at prices that wouldn't leave you speechless.

Now every computer can, and should have a voice—it's simple, easy, and inexpensive. Let's take a look at how text-to-speech systems work and how you can use them with your computer.

Natural Synthetics

Simply stated, voice synthesis is the conversion of digital information to recognizable speech (in the majority of systems presently on the market). In actual operation, though, a synthesizer is much more complex.

We humans have vocal chords, a mouth, tongue, and lips to control the various sounds we make. A synthesizer must create them all electronically by the use of sound and noise generators, filters, timers, and delay circuits.

In a typical text-to-speech (TTS) system, the operator keys words in on his computer. These words are then sent to a text-to-speech translator or algorithm, which in this case, is a set of well defined prounciation rules.

The speech synthesizer then receives these modified signals, and through the use of various periodic and continuous sound generators, creates human sounding speech. After passing through a digital-to-analog converter, the synthesized signal is amplified and fed to a speaker.

In simpler terms: You type in h-e-l-l-o and you hear "hello."

In many TTS systems, the voice we hear over the speaker is a string of individual sounds called phonemes. There are several dozen different phonemes in the English language and they represent the sound created by uttering the letters in our alphabet during regular speech. Vowels have more than one phoneme each, since they can be long or short. Combinations of letters such as th and sh have their own unique phonemes.

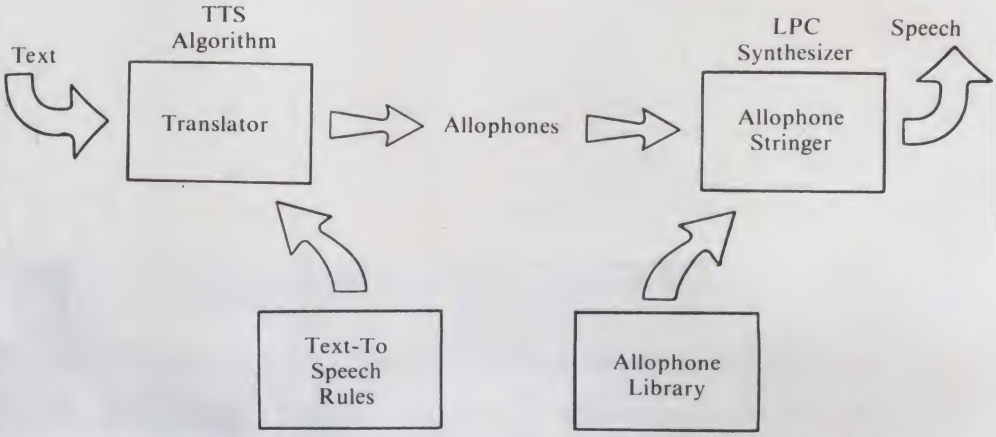
A few of the synthesizers on the market, particularly the Texas Instruments TMS5200 chip found in their Terminal Emulator II package, and the Echo from Street Electronics, create allophones, which are in effect "sons" of phonemes. There can be several allophones for each phoneme, such as the aspirated p in "pit," and the unaspirated p in "spit." A synthesizer based on allophone creation is usually more versatile than a phonemic synthesizer, although both can produce highly recognizable speech.

The ability to program a synthesizer sound by sound, instead of by prerecorded voice digitization, leads to the possibility of limitless vocabularies. English includes several of the sounds encountered in many foreign languages, so some of the synthesizers are capable of speaking German, Spanish, and French as well.

A Closer Look

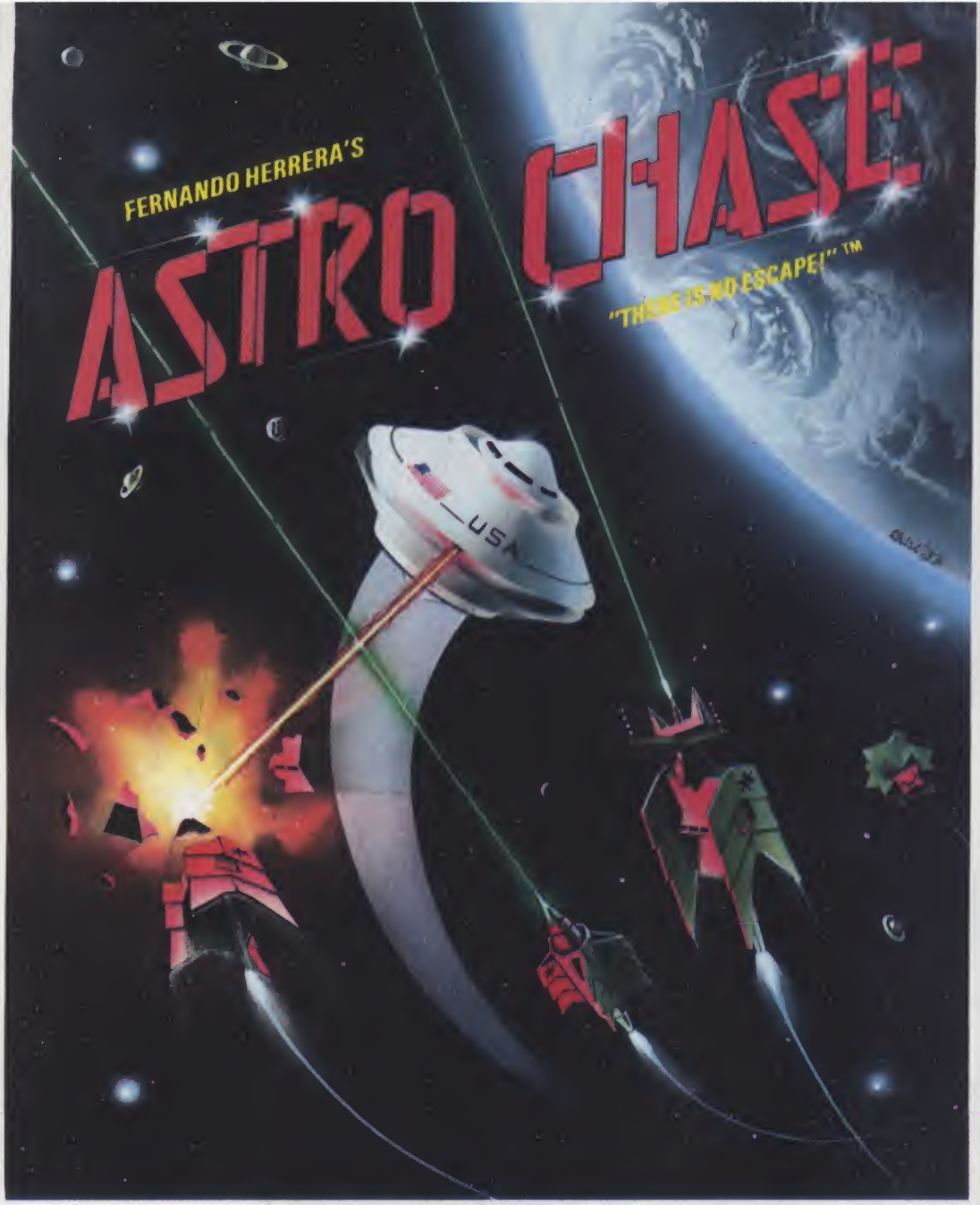
Most synthesizers employ two types of sound generators to produce speech: a voiced source and a fricative source. Voiced sounds include vowels and some consonants that have vowel sounds in them, such as v and z. Rs and ws are also produced by the voiced sound generator of most synthesizers.

The fricative generator is responsible for almost all of the consonants and can be characterized by a phoneme or allophone with a "noisy" rasp to it. Fricatives include s, k, f, sh, th, and so forth. For more details on sound



This is a block diagram of the Terminal Emulator II from Texas Instruments. As text is entered into the computer, the TTS algorithm module first translates the text into its allophonic equivalent and uses pre-programmed text-to-speech rules to compensate for pronunciation variances. The TTS module also includes rules for sentence contouring. The modified allophones are then converted to Linear Predictive Coding (LPC) strings. These strings are, in turn, processed through the TMS5200 speech synthesizer and spoken.

Gordon Mc Comb, 410 Escondido Avenue, Vista, CA 92083.



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categories, refer to Table #2.

The signals from these two generators are then fed to a series of filters which is designed to mimic the human vocal tract. Texas Instruments uses a 12-stage network that includes 10 types of filters to alter the sound, as well as pitch and volume control. The pulses outputted by the filters are in digital form and must be fed to a digital-to-analog converter before they can be processed by an amplifier and heard as speech.

However, simply producing a string of vowels and consonants together without smoothing out the transitions will sound awkward and stilted. *Dynamic articulation*, or the transition between sounds, must be smooth, or the resultant speech will be nothing more than a series of choppy gibberish.

Voice synthesizers employ circuitry that slopes the beginning and ending of each phoneme or allophone. As an example, divide the word "computer" into its component sounds and you come up with something like: k-um-pu-t-er. Speak each of these phonetically without transitions and you have a word that is impossible to understand. Smooth out the transitions and you might come up with "kum-pew-ter." There. You can understand that.

While infants are learning to speak, they imitate not only sounds, but the inflections of voices as well. The rising and falling pitch of words and sentences aids in comprehension. Unfortunately, most hobby TTS synthesizers lack control in this area.

Serious programming and manufacturing advances have been developed to control the pitch of the voice and the playback to some extent. A few synthesizers for the personal computer market make it possible to control pitch under software control. It is also possible to pace the syllables and phrases better to create more lifelike sounding speech.

Text Into Speech

So far, we have discussed how a synthesizer changes digital pulses into synthetic speech. But programming in binary or by using special codes can be painful and time consuming. With the aid of the proper software or firmware, it is possible to convert words written on a computer keyboard into the code necessary for the synthesizer.

What's more, you can alter certain words to conform to basic English language pronunciation. The algorithm guidelines that accomplish this are the basis for all text-to-speech voice synthesis. TTS algorithms convert complete words and sentences into correctly pronounced speech.

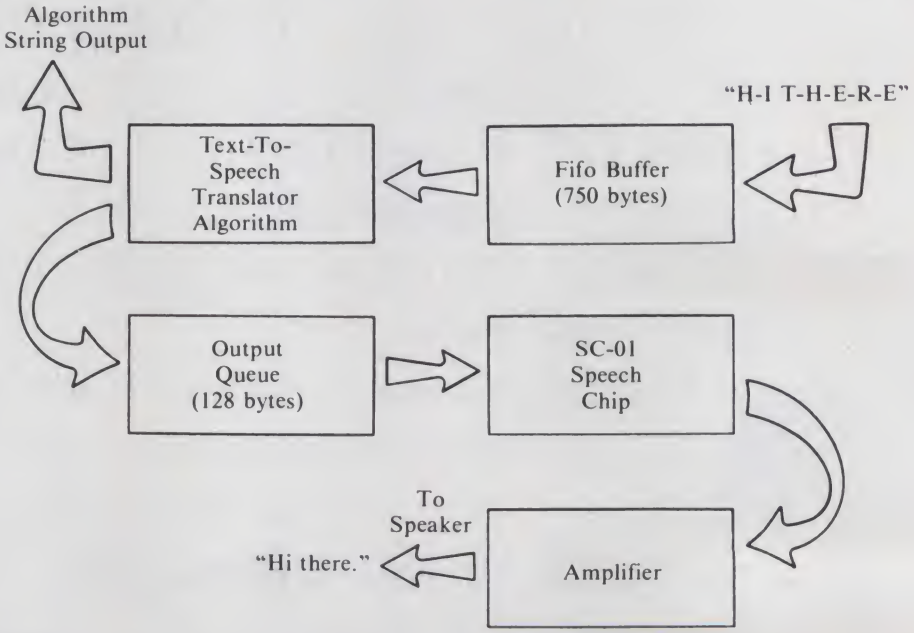
Algorithm programs, whether they be embedded in a memory chip inside the synthesizer (such as Type 'n Talk) or contained in software (such as the Echo/Textalker), look at each letter individually, then scan to either side to see how other letters in the word will affect pronunciation. The unit then searches a *rule table* so it can compare the scanned words with its stored definitions. When it sees a match, it corrects for proper pronunciation as indicated. If it doesn't see a match, it outputs the speech without any conversion.

Programming With TTS

As you may have guessed, text-to-speech synthesizers will not produce every word they encounter perfectly. There are simply too many exceptions to the rules of English language pronunciation, and no program or device, no matter how complicated, can cope with them all.

Overall accuracy exceeding 90% is possible in some of the more complicated industrial TTS synthesizers; the personal computer units are somewhat less accurate, but are usually more than adequate for the job.

The Votrax Type 'n Talk.



This is a block diagram of the Votrax Type 'n Talk. ASCII information is fed into the unit via an RS-232C output. Up to 750 bytes (about a minute of speech) can be temporarily stored in a first-in/first-out buffer. From there, the ASCII string is sent to the text-to-speech algorithm. The algorithm serves two purposes: it examines each word and corrects for pronunciation errors, and it converts the newly modified speech string into a form that can be readily inputted into the synthesizer. The 128-byte output queue is used as an extra storage block for translated data. The string is then sent into the SC-01 speech chip which creates a series of humming, clicking and other unique noise that combine to make human sounding speech. The chip has an on-board D-to-A converter so its output can be directly routed to the internal 1-watt amplifier.

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Table 1. Phoneme Chart.

Phoneme Code	Phoneme Symbol	Duration (ms)	Example Word
ØØ	EH3	59	jacket
Ø1	EH2	71	enlist
Ø2	EH1	121	heavy
Ø3	PAØ	47	no sound
Ø4	DT	47	butter
Ø5	A2	71	made
Ø6	A1	103	made
Ø7	ZH	90	azure
Ø8	AH2	71	honest
Ø9	I3	55	inhibit
ØA	I2	80	inhibit
ØB	I1	121	inhibit
ØC	M	103	mat
ØD	N	80	sun
ØE	B	71	bag
ØF	V	71	van
1Ø	CH*	71	chip
11	SH	121	shop
12	Z	71	zoo
13	AW1	146	lawful
14	NG	121	thing
15	AH1	146	father
16	OO1	103	looking
17	OO	185	book
18	L	103	land
19	K	80	trick
1A	J*	47	judge
1B	H	71	hello
1C	G	71	get
1D	F	103	fast
1E	D	55	paid
1F	S	90	pass

Phoneme Code	Phoneme Symbol	Duration (ms)	Example Word
2Ø	A	185	day
21	AY	65	day
22	Y1	80	yard
23	UH3	47	mission
24	AH	250	mop
25	P	103	past
26	O	185	cold
27	I	185	pin
28	U	185	move
29	Y	103	any
2A	T	71	tap
2B	R	90	red
2C	E	185	meet
2D	W	80	win
2E	AE	185	dad
2F	AE1	103	after
3Ø	AW2	90	salty
31	UH2	71	about
32	UH1	103	uncle
33	UH	185	cup
34	O2	80	for
35	O1	121	aboard
36	IU	59	you
37	U1	90	you
38	THV	80	the
39	TH	71	thin
3A	ER	146	bird
3B	EH	185	get
3C	E1	121	be
3D	AW	250	call
3E	PA1	185	no sound
3F	STOP	47	no sound

/T/ must precede /CH/ to produce CH sound.

/D/ must precede /J/ to produce J sound.

Table 2. Categories According to Production Features.

Voiced					'Voiced' Fricat.	'Voiced' Stop	Fricative Stop	Fricative	Nasal	No Sound
E	EH	AE	UH	OO1	Z	B	T	S	M	PAØ
E1	EH1	AE1	UH1	R	ZH	D	DT	SH	N	PA1
Y	EH2	AH	UH2	ER	J	G	K	CH	NG	STOP
Y1	EH3	AH1	UH3	L	V		P	TH		
I	A	AH2	O	IU	THV			F		
I1	A1	AW	O1	U				H		
I2	A2	AW1	O2	U1						
I3	AY	AW2	OO	W						

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WALDREP

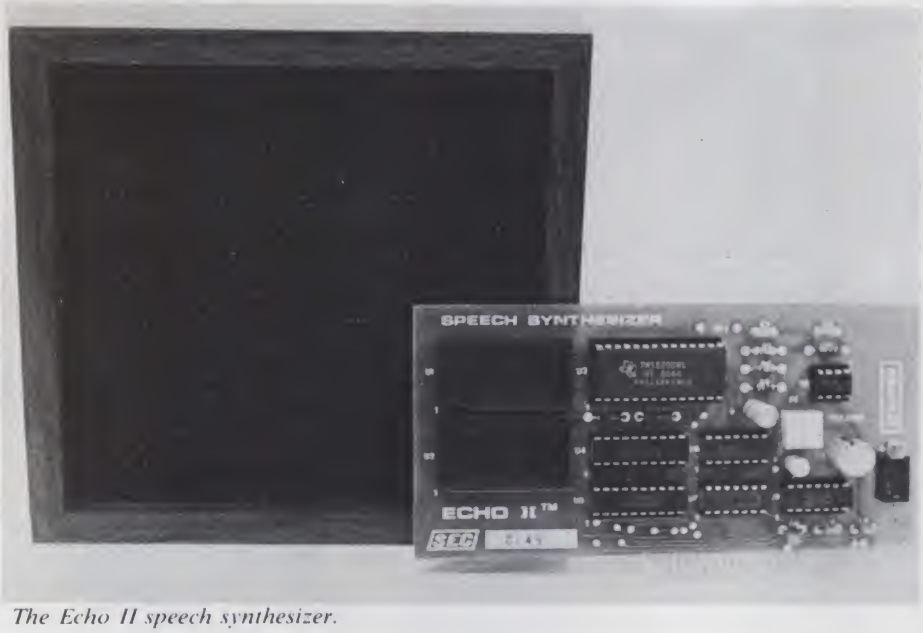
When working with a good TTS system, you can "bend the rules" to make words sound better. This can be done in a variety of ways. The most basic is to misspell the word. "Clothes" will sound a bit odd on a voice synthesizer so you might mispell it "cloze."

Words can also be split to help in pronunciation and timing. "Computer" usually sounds strange so you might change it to "com puter." Likewise, the text-to-speech translator would have a heck of a time pronouncing a word like "baseball," since it wouldn't recognize the long a and silent e. ("Baseball" doesn't follow the standard rules, mainly because it is a compound word.) Breaking it up into "base ball" easily corrects this fault.

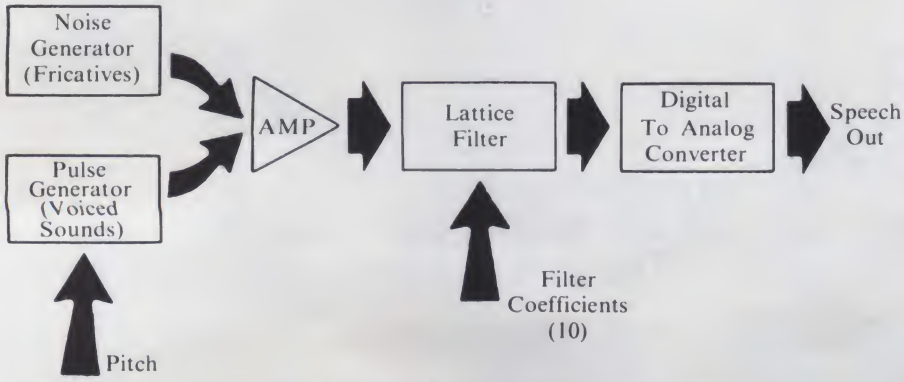
The third way of dealing with an exceptionally difficult word is to bypass the TTS algorithm and access the speech synthesizer directly. This can usually be done under software control and greatly aids in better programming. If a particular sound isn't quite right, you can easily substitute for it by using the proper codes.

In Use

There are many ways to use voice synthesis with your computer. Text-



The Echo II speech synthesizer.



The Texas Instruments TMS5200 speech synthesizer chip uses two sound generators. One produces fricatives (f, s, k, sh, etc.); the other voiced sounds (e, i, a, o, etc.). An amplifier boosts these signals which are in digital form, then sends them to a lattice filter network. The filters are based on a mathematical reconstruction of the human vocal tract. After the incoming data has been modified by the filters, it is converted to analog signals, then amplified. The speech that results is of very high quality and easy to understand. The TMS5200 can be controlled by prestored ROM data (like that found in Speak 'n Spell) or information inputted by a CPU.

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to-speech clears the way. A good introduction to TTS voice synthesis would be to use it in connection with a simulation or adventure game. Load up *The Count*, or other game and you and your synthesizer can explore dungeons, escape evil vampires, and together, glory in all your plundered loot.

Another use might be as a prompt for education and computer aided instruction programs. With a voice synthesizer, the screen is free to display graphics and other detailed data.

Voice synthesis, in conjunction with text-to-speech, can be a great help to the verbally and visually handicapped. Both outgoing and incoming messages can be transmitted easily and with surprising intelligiblity.

Since voice output from a computer frees you from continually looking at the screen, business programs can be enhanced and simplified. A bookkeeper can input names and account balances and *hear* confirmations and totals.

Voice synthesis can make your personal programs more lively and entertaining. The personalized flavor helps attract and hold attention.

Other uses include connecting the synthesizer to a telephone amplifier and auto-answer modem. Program the computer to answer the phone while you are away and have it playback a synthesized message. An elaborate set up might enable your computer to answer specific questions—questions asked by the caller by pushing a button on a Touch-Tone telephone.

Voice synthesis should be an integral part of your system, but not the center of it.

To be used most effectively, voice synthesis should be an integral part of your system, but not the center of it. Take care not to go overboard. Use voice synthesis when it will get the message across best. Overuse it, and it might become a tired fad.

You will probably find it a little difficult to understand everything a voice synthesizer says during your first couple minutes of speech. You especially need a break-in period with a TTS synthesizer since you must accustom yourself to the sometimes strange pronunciation of certain words. But like any dialect, you can quickly catch on to its idiosyncrasies and learn to understand perfect "synthesizer-eze."

Voice synthesis is being used in toys and games, microwave ovens, and cars—so why not wait with your home computer. You will find the new dimension of speech a welcome addition to your system—one that is cost effective and useful as well.

And with the added advantage of easy to program text-to-speech encoding, work that used to take hours can be accomplished in just minutes. So give your computer a voice. □

Firms Mentioned In This Article:

Street Electronics Corp.
1140 Mark Ave.
Carpinteria, CA 93013

Texas Instruments Incorporated
Consumer Relations
P.O. Box 53
Lubbock, TX 79408

Vodex (for Votrax products)
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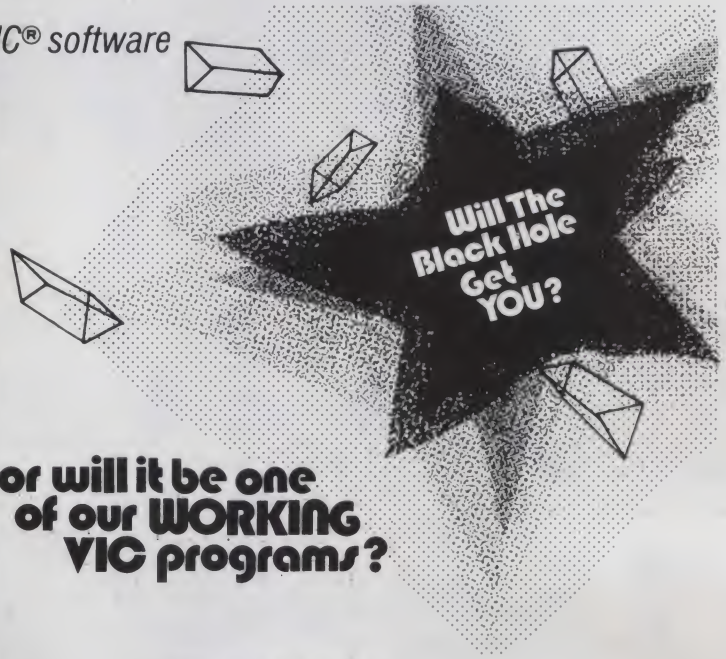

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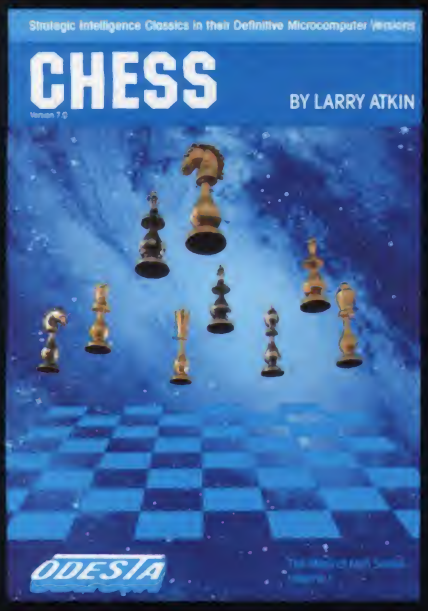

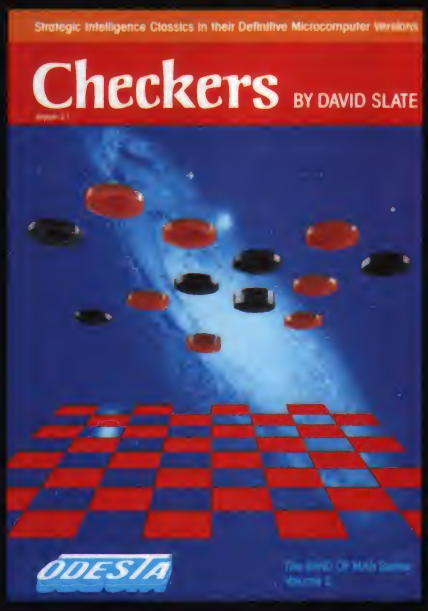

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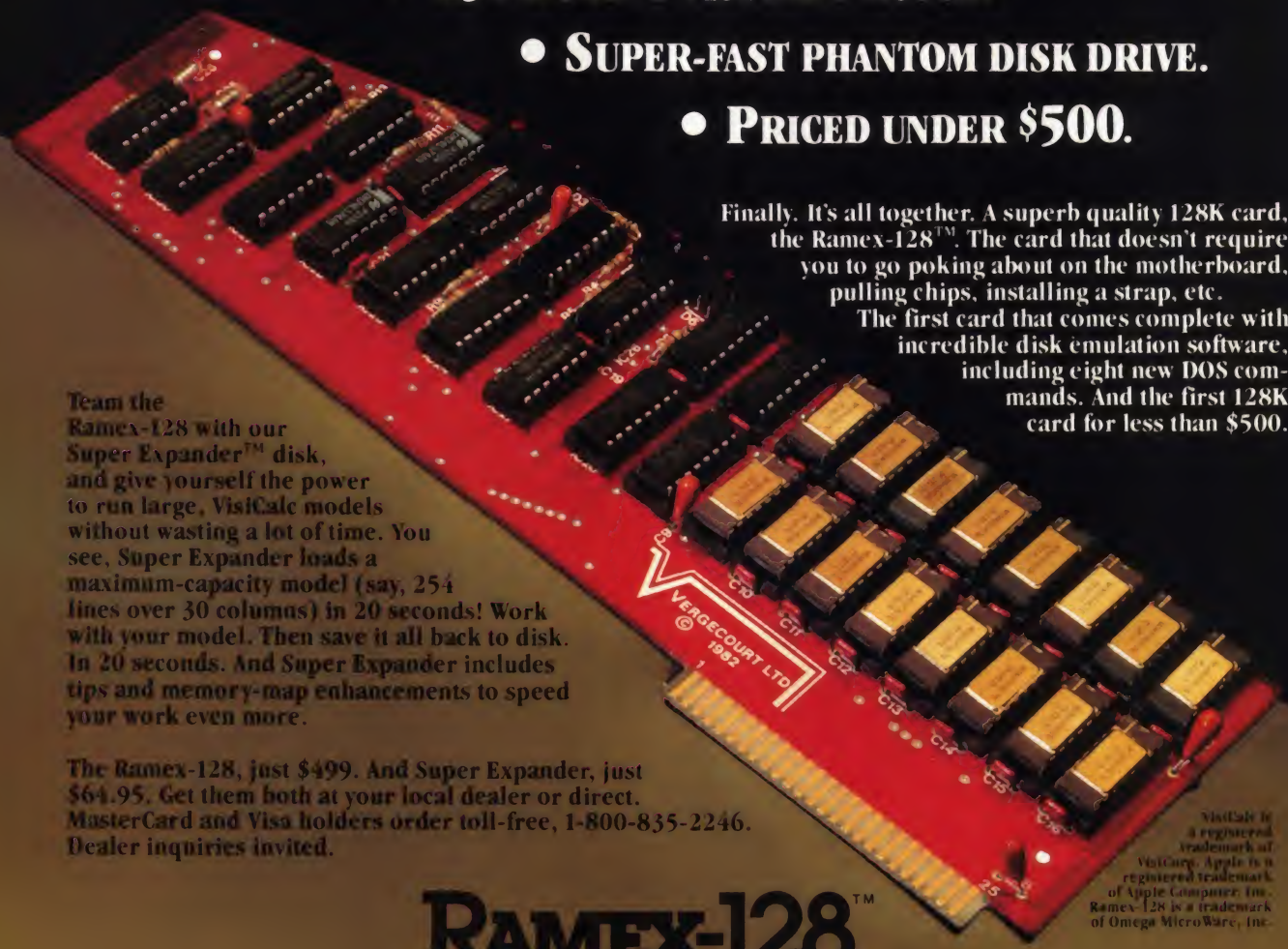

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Talk is Getting Cheaper

John Anderson

Giving your computer the power of speech is no mere frill or gimmick. The potential of such capability, for the handicapped as well as microcomputer users at large, is dramatic.

For as long as microcomputers have been around, the cost of such potential has remained a prohibitive factor. But that is changing fast.

Following is a look at three speech synthesis packages for the Atari computer. These packages represent the range of possible configurations: the first is an independently powered piece of hardware, which can hook up to any microcomputer using a serial or parallel port; the second consists of an Atari specific external module, driven by software; the third works entirely in software, using the synthesizer chip already in the Atari.

The Echo GP

I have had an opportunity to experiment with the Echo Speech Synthesizer, from the Street Electronics Corporation, for quite a while now. It is a sophisticated unit, while at the same time fun to use.

It is based on the Texas Instruments TMS 5200 speech processor chip. This is in contrast with its nearest competitor, the Votrax Type 'n Talk, which uses the Votrax chip.

The unit makes use of its own 6502 microprocessor, and interfaces as if it were a printer. It is available in RS-232 serial or Centronics parallel versions. This means that the 850 interface is needed to drive the Echo from an Atari computer. We received the serial version, and controlled it through the 850 using Atari Basic.

Upon power-up, the Echo unit responds with the phrase "Echo ready," to let you know all is well. One of the first points the user will notice is that the Echo is capable of intoning a sentence. Rather than speaking in monotone, the pitch of the voice is dynamic. This makes for a more intelligible and less grating speech quality.

You can use the internal speaker of the unit or route the sound to an external speaker. I found it convenient (as did those around me) to use an earphone when involved in speech editing sessions.

Textalker

Textalker is the ROM based program Echo uses to convert English into speech. Echo can translate English text into phonemes directly, with an impressively low error rate. It can be disorienting, but even when Echo mispronounces a word or syllable, the listener can usually make sense of the sentence from its context.

This is not to say that Echo has the diction of Henry Higgins. In fact, it takes a bit of time to become accustomed to the unique "accent" of the unit. As is the case with some foreign speakers, accustomed listeners will typically understand words that first-time listeners will miss. Echo has trouble with the "g" sound in words like "go," and "l" sounds give it problems as well.

In this respect, the monotone of the Type 'n Talk wins out. (A thorough review of the Votrax unit appears in the

		Do	Re	Mi	Fa	So	La	Ti	Do
Octave 1	-	12	15	18	20	23	26	29	31
Octave 2	-	31	34	37	39	44	48	51	53
Octave 3	-	53	56	58	61	63			

Figure 1. A rough pitch table to give the synthesizer a singing voice. Flats and sharps can also be supported, but I have not taken the time to locate them.

```
10 REM ECHO SINGS ITS HEART OUT
20 REM ASSUMES SERIAL PORT IS OPEN AND CONFIGURED
30 DIM I$(100)
40 READ I$
50 IF I$="STOP" THEN STOP
60 PRINT #1,I$
90 GOTO 40
1000 DATA ┐12F
1010 DATA SOME
1020 DATA ┐31F
1030 DATA WHERE
1040 DATA ┐29F
1050 DATA OAV
1060 DATA ┐23F
1070 DATA ER
1080 DATA ┐26F
1090 DATA THE
1100 DATA ┐29F
1110 DATA RAIN
1120 DATA ┐31F
1130 DATA BOW
1140 DATA ┐12F
1150 DATA SKIES
1160 DATA ┐26F
1170 DATA ARE
1180 DATA ┐23F
1190 DATA BLUE
1200 DATA STOP
```

Figure 2. With a singing synthesizer your micro won't be in Kansas anymore. The character " ┐ " is what control-e looks like on the screen.

September 1981 issue of *Creative Computing*.) Though it also has its share of vocal peculiarities, it does, on the whole, enunciate more clearly than the Echo. And yet, for extended periods, I would much rather listen to the Echo. The monotone of the Votrax unit gets me down after a while—too "computerish." It was an unfortunate design decision. The Votrax chip itself, as we shall soon see, does allow for software pitch control which results in much more natural sounding speech.

The features of Echo are accessed through control characters. For instance, pressing CONTROL-E will enable the Textalker command set. Following this character with a number from 1 to 63 will determine pitch, which can be toggled from f (for flat, meaning unintoned), to p (for pitched, meaning intoned). In what I think is a first for microcomputers, I found that the Echo could be programmed to "sing" through careful use of these commands. In fact, the unit provides for about three octaves. Not a bad range! A pitch table and sample program appear below.
be controlled by text punctuation. A comma will create a pause, a period will cause a drop in pitch at the end of a sentence, and a question mark will result in a rise in pitch.

Textalker can also be commanded to pronounce each punctuation mark it encounters. Similarly, the user may choose to have all upper case letters pronounced as letters (use this mode to get IBM to sound right), or to have all words spelled out letter by letter.

The rate of speech may also be compressed resulting in twice the text in the same amount of time. Remarkably, this function sometimes increases rather than decreases the intelligibility of certain sentences.

I found that the Echo could be programmed to "sing."

According to the documention, the Textalker component of the Echo Speech Synthesizer "contains close to 400 rules which allow it to correctly pronounce over 96% of the thousand most commonly used words in English."

I was pleasantly surprised at how well Echo did with unaltered text. Having worked with phonemically-based sythesizers in college, I realized this was quite a feat. Of course there are some words Echo has trouble with. Fortunately, an appendix, which outlines the kinds of fixes to apply to these words, is provided. They are as simple as the addition of a space, such as "cre ate" for the word "create," or the spelling of the word "question" as "kwestchun."

Phoneme Generator

In addition to the Textalker module, speech can be programmed at the phonemic level, using the Speakeasy Phoneme Generator, also resident in firmware. This mode is selectable by the character CONTROL-V, and provides for much more detailed control. Stress, pause, pitch, volume, and rate controls can be embedded directly into the text strings.

This approach requires the use of a phoneme code, detailed in the documentation. It bears little resemblance to any phonetic alphabet I have come into contact with, but the 48 sounds it provides are more than enough to do the job.

Unfortunately, the effort it takes to achieve satisfactory results using this approach is somewhat unreasonable, especially in contrast to the serviceable job Textalker does. However budding linguists should take note. The phonemic approach offers great experimentation potential. I did manage to get the Echo speaking a little German.

The Echo Speech Synthesizer lists for $300, which is admittedly a bit stiff. Still, it is comparable to the price of the Type 'n Talk. And if you want your micro to sing Thomas Dolby tunes, the Echo is the only choice.

Hooking Up

In March of this year *Creative* ran a review of the Echo Speech Synthesizer board for the Apple II. At that time, Textalker and Speakeasy were in the development stage. The Speech Synthesizer offers much greater flexibility and power, as well as the capability for connection to any personal computer.

However this does not automatically imply *easy* connection. Even with our experienced people here at the magazine, it took us a while to make the Echo conversant with the Atari.

The documentation that arrived with our Echo was preliminary. All the information we needed was there; I do hope that the final documentation will be an improvement, though.

The real fault lies with the 850 interface module documentation: it provides beginners with quite a run for their money. Here is a way to succeed.

The first thing to do is wire an interface cable, by connecting a DB-9 male to DB-25 male connector. The pinouts given in Figure 3 work with serial port number 1 on the 850.

Next you need to configure the Echo and port number one so that communication may be established. I used a data transfer rate of 1200 baud. This entails setting the DIP switches on the bottom of

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the Echo so that positions 1 and 2 are on, while position 3 remains off. Position 4 also remains in the off position to enable "handshaking," as we say in the trade.

The serial port is configured through software. Figure 4 shows an example of this configuration, as well as a short program allowing for straightforward experimentation with the unit.

Make sure the 850 device handler is booted whenever using the serial port. This occurs as an autorun.sys file on the Atari DOS disk. Make sure it is resident on any program disk for use with the unit. Power up the 850, then boot a disk with the handler file. You will then be set to go.

For more information concerning the Echo, contact Street Electronics, 1140 Mark Ave., Carpinteria, CA 93013.

Male DB-9 (to serial port #1)	-	Male DB-25 (to Echo GP)
Pin 1		No connection
Pin 2		No connection
Pin 3		Connects to pin 3
Pin 4		Connects to pin 2
Pin 5		Connects to pin 7
Pin 6		Connects to pin 20
Pin 7		Connects to pin 5
Pin 8		Connects to pin 4
Pin 9		No connection

Figure 3. Wiring a cable for connection to the Atari 850.

The Alien Group Voice Box

The Echo has everything it needs to effect speech synthesis onboard. Like a printer, it awaits a stream of characters; it would just as soon pronounce text files from bulletin board services, Compuserve, or the Source. The Atari, thus, is free to do whatever processing you have in mind, while the Echo works independently.

This is a fine capability, but also an added expense. The Voice Box from Alien Group takes some of the internal, ROM based capabilities of the Echo, and efficiently uses Atari RAM for their storage. The Voice Box uses a Votrax SC-01 chip, and connects directly to the Atari input/output jacks. It will necessarily be the final connection in the I/O daisy chain, as it offers no jack of its own.

The external module is no bigger than a transistor radio, and draws power directly from the Atari. It lists for $170, including driver software, which is available in cassette or disk versions.

The Voice Box is manipulated from Atari Basic, and does not offer an RS-232 handler program. Using patches from Basic, however, it can be controlled from a machine language program.

Your machine must have at least 16K to run the Voice Box. If you have 32K or more, you can run two additional programs included with the package: the Random Sentence Generator and the Talking Face. More about these later.

When the driver program is run, the box responds with the phrase "Please teach me to speak," or if a dictionary is loaded, the words "Yes, Mahster," to let you know everything is working.

While calling on its own phonetic input code, as does the Echo, the system also uses a unique approach to convert character strings into speech sounds. English text and phonetic code may be freely intermixed, rather than requiring separate modes, as is without exception the case with every other text-to-speech system I have seen.

Dictionaries

The key to working with the Voice Box is the creation of your own *dictionaries*. These are the "word equations" specified to translate words into phonemes. For example, by typing "spek=speak," you will ensure that each time the word "speak" is encountered, it will be pronounced correctly. Dictionaries are saved and re-called, as independent files, to cassette or disk. In addition to those you create, three pre-written dictionaries are supplied with the driver software.

Dictionaries eat up computer memory quite quickly—each word equation takes up ten bytes. In order to store phonemes more effeciently, word *fragments* can be stored. You can define fragments to be recognized only at the beginning or the end of a word, or at every occurrence.

Because dictionary size is limited, the dictionary approach itself is necessarily limited. Even with 48K, no dictionary is going to produce impressively accurate text-to-speech capability. In this respect, the Echo has a much more sophisticated algorithm. This is the main trade-off between the two systems.

In fact, if you have more than 32K, you must change the dimensions of a string statement in the Voice Box driver program in order to store larger dictionaries. The documentation clearly states how to do this.

Other Features

Similar to the Type 'n Talk, the Voice Box sports a potentiometer knob on the front of the case, that can be used to vary the speed and pitch of the speech. The Voice Box unit allows for pitch control through software, too. Control is restricted to four registers, utilizing the slash and the backslash characters to move between them. This negates the musical capabilities of the unit, but is a step ahead of the monotone of the Type 'n Talk.

Because so much of the Voice Box is RAM resident, you must decide how much of the memory of the Atari to allot to dictionary space, in addition to your own Basic programs, and the Voice Box driver. The disk version includes a pared-down driver program for incorporation into other programs. The documentation also gives hints for memory conservation.

```
10 OPEN #1,12,0,"R1:"
20 XIO 36,#1,10,6,"R1:"
30 DIM I$(100)
40 I$="↑15P HI THERE. THIS IS ECHO G P.,, READY
   WHEN YOU ARE.,, OVER."
60 PRINT #1,I$
70 INPUT I$
80 PRINT #1,I$
90 GOTO 70
```

Figure 4. It is this simple to configure serial port number one and input text for synthesis. Again the "↑" character signifies control-e. Don't forget to boot the device handler prior to running the program.

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In the 32K version, several other features appear. The first is the Random Sentence Generator. The Voice Box will compose random but grammatically correct sentences from its stored word lists. These can be modified with word lists of your own creation. I obtained some rather strange results in my attempts at this. While many were semantically bizarre, I must admit the sentences were grammatically unassailable. Be prepared for a few shocks when you try this.

There is also a mode called The Talking Face. This displays an animated face, with impressive lip synch simulated as words are articulated by the Box. I am sure this feature would be a big hit with the kids.

The documentation accompanying the system is a bit uneven in places, but manages to cover all the features of the Voice Box in a scant nine pages. The phoneme list is quite complete. The documentation also goes as far as to suggest to assembly language programmers a means of updating data to the box while running machine language animation routines.

While the Voice Box is not really in the same league as the Echo, it offers many of the same features for much less money. For more information contact the Alien Group, 27 West 23rd St., New York, NY 10010.

The game* Tumblebugs *taught the Atari its first words: "We gotcha!"

The Software Automatic Mouth

In the September 1982 issue of *Creative*, I mentioned that the Atari was capable of speech synthesis using only its internal hardware. The game *Tumblebugs* taught the Atari its first words: "We gotcha!" This came as a happy revelation to many.

Well with *Software Automatic Mouth, SAM* for short, Mark Barton has brought this possibility to fruition. He has created a disk-based, unlimited speech synthesis program, requiring *no* external hardware. And the speech quality of *SAM* competes favorably with the *best* systems available for microcomputers.

SAM uses the Atari sound chip, Pokey, to generate speech. Even with my unbridled faith in the capabilities of the Atari, I was quite surprised at how well it does the job. Pokey is at least as intelligible as its two competitors, the TI and Votrax chips.

SAM is the only package around that dares to include lengthy prepared speech demonstration programs to show off its articulative powers. My colleagues agreed that no break-in period was necessary in order to understand *SAM*.

The documentation supplied is equally impressive. It not only makes operation of the program very simple, but provides background information concerning linguistics and speech synthesis. It helps to make the program into an excellent tutorial on the subject.

I did encounter one snag, if only in my eagerness to get rolling with the package. You must copy all the Basic programs from the master disk to a new diskette. The autoboot assembly language program that constitutes *SAM* runs from the master, but support programs must be loaded from the new disk. The reason is that the support programs require a mem.sav file. The write-protected master disk will, of course, return an error if a mem.sav attempts to write to it. The documentation clearly states that you must use an un-write-protected new disk with a mem.sav file on it. In my excitement to get going, I did not heed these instructions, and ended up wasting some time.

Support programs included with the package are: Reciter, which is an English text-to-speech translation program; Sayit, the short Basic program which makes experimentation simple; Demo and speeches, two files that impressively demonstrate the powers of *SAM*; and Guessnum, a spoken version of a number-guessing game.

An RS-232 handler program is also provided, allowing *SAM* to act as Echo does to read telecommunications text.

It is extremely simple to work with *SAM* from Basic. All that is needed is to define SAM$ as it appears in Basic, and then invoke either *SAM* or Reciter through a USR call. You can also effect machine language patches from Basic.

Speech Quality

The really remarkable thing about *SAM* is its (his?) intonation—*SAM* can be extremely expressive. Control of stress placement is easy. The phonetic code is a bit strange, but very nicely laid out in the

SAM Speaks Apple II

The Apple II has no special advantage over the Atari when it comes to speech synthesis. The Echo, Votrax, and many other voice systems work equally well for both computers.

The history of software-only synthesizers for the Apple dates back to 1979 when Softape published a program called Apple Talker. That program has been discontinued, but Muse publishes The Voice, an inexpensive program that serves the same purpose. Sirius Software, the renowned game publisher, produces Audex, a general purpose audio program that can be used to approximate speech. For the most part, these programs deliver results that are interesting, but only sporadically intelligible.

Hardware voice products for the Apple also abound. Voice input can be recognized by peripherals from Scott Instruments, among others. Mountain Computer carries a remarkable input-ouput device that turns an Apple into a digital audio recorder.

At $130 for the Apple version, SAM is the first product to combine unlimited vocabulary, impeccable intelligibility, and reasonable price.

The SAM package includes a little bit of hardware and a little bit of software. The hardware is a board containing a digital-to-analog converter, a tiny amplifier, and an even tinier volume control. The software includes all the programs described in the main part of this article.

SAM sends output to an 8-ohm speaker. You can use the speaker inside your Apple or, for better results, attach a slightly larger one. Installing SAM is no more complicated than hooking an Apple to a TV set.

SAM uses the simplest possible interface to a sound system. In exchange for the simplicity of the hardware, the developers had to write large and complex programs. The program that produces speech based on phonetic codes occupies 9K of RAM. Another program that translates English text into phonetic codes requires an additional 6K. These programs live in an area usually reserved for Applesoft string variables. The English translator also overlaps the memory associated with the second graphics image (Hi-Res page 2) of the Apple.

Because of these requirements, SAM can not cooperate with most other programs. You can not add speech capability to your word processor or terminal program, for example. Pascal, Logo, Graforth, and most other languages can not use SAM.—*MC*

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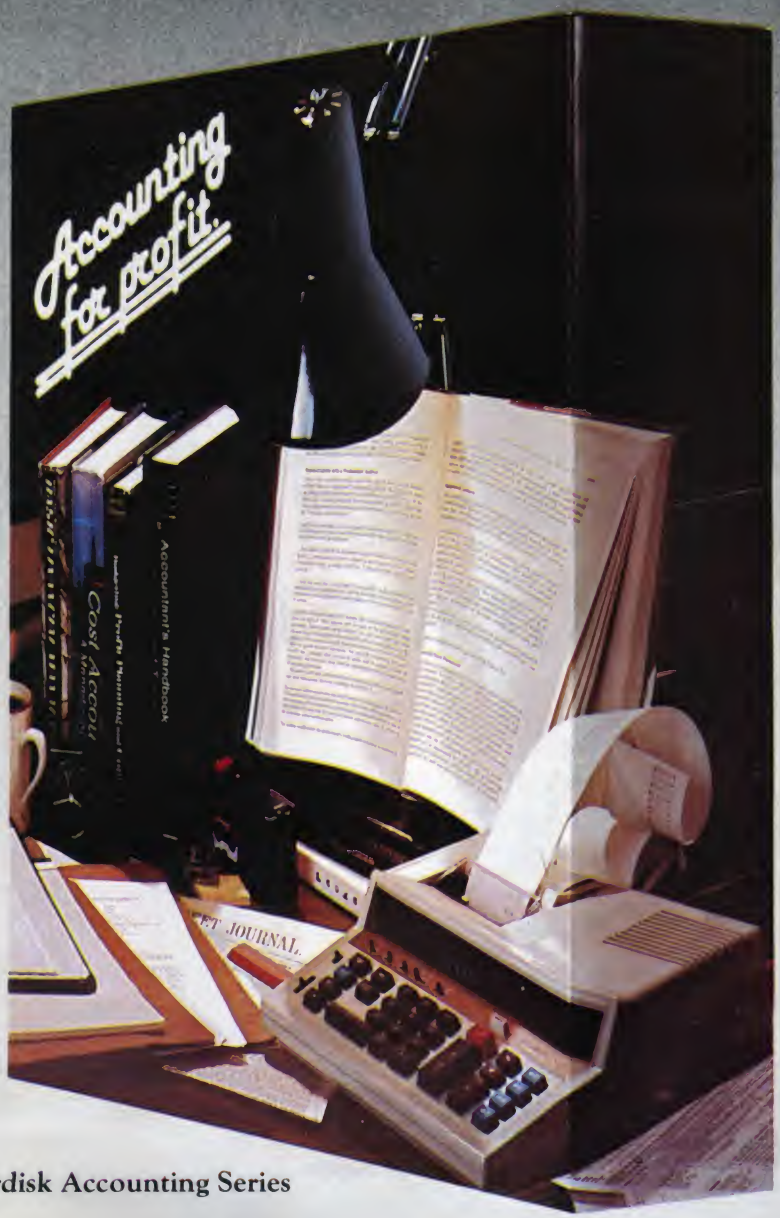

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Figure 5.

PHONETIC ALPHABET FOR S.A.M.

The example words have the **sound** of the phoneme, not necessarily the same letters.

VOWELS

IY	f**ee**t
IH	p**i**n
EH	b**e**g
AE	S**a**m
AA	p**o**t
AH	b**u**dget
AO	t**a**lk
OH	c**o**ne
UH	b**oo**k
UX	l**oo**t
ER	b**ir**d
AX	gall**o**n
IX	digi**t**

DIPHTHONGS

EY	m**a**de
AY	h**igh**
OY	b**oy**
AW	h**ow**
OW	sl**ow**
UW	cr**ew**

VOICED CONSONANTS

R	**r**ed
L	**l**low
W	**w**ay
WH	**wh**ale
Y	**y**ou
M	Sa**m**
N	ma**n**
NX	so**ng**
B	**b**ad
D	**d**og
G	a**g**ain
J	**j**udge
Z	**z**oo
ZH	plea**s**ure
V	se**v**en
DH	**th**en

UNVOICED CONSONANTS

S	**S**am
SH	fi**sh**
F	**f**ish
TH	**th**in
P	**p**oke
T	**t**alk
K	**c**a**k**e
CH	spee**ch**
/H	a**h**ead

The following symbols are used internally by some of S.A.M.'s rules, but they are also available to the user.

YX	diphthong ending
WX	diphthong ending
RX	R after a vowel
LX	L after a vowel
/X	H before a non-front vowel or consonant
DX	"flap" as in pi**t**y

SPECIAL PHONEMES

UL	sett**le** (= AXL)
UM	astron**om**y (= AXM)
UN	functi**on** (= AXN)
Q	kitt-en (glottal stop)

Note: The symbol for the "H" sound is **/H**. A glottal stop is a forced stoppage of sound.

Figure 6.

```
0 GRAPHICS 0
10 REM --DEMO--
20 DIM SAM$(255):SAM=8192
25 X=0
30 SETCOLOR 2,0,0:SETCOLOR 1,0,0:SETCOLOR 4,0,0:SETCOLOR 3,0,0
40 SPEED=8208:PITCH=8209
45 X=X+5:IF X>45 THEN X=0
50 POKE SPEED,X:POKE PITCH,100
60 SAM$="ULEHKTRAA4NIXK /HULUW4SIXNEY5SHUNS."
70 A=USR(SAM)
80 GOTO 45
```

documentation (see Figure 5). A reference card is also provided.

Similar to the Echo, punctuation is "understood." A hyphen is read as a short pause, and is handy for delineating clause boundaries. A comma inserts a pause equivalent to two hyphens. A question mark also inserts a pause, as well as making the pitch rise at the end of a sentence. Likewise a period makes the pitch fall.

SAM is capable of speaking only 2.5 seconds without a break. If a string exceeds that length, a short break will automatically be inserted. If you don't like the placement of automatic breaks, you can stipulate their positions with hyphens. The breaks are so short as to be hardly noticeable, and cause few problems.

SAM can be controlled more creatively and flexibly than Echo or Voice Box. The pitch and speed of *SAM* speech can be altered through with POKE statements. I got some wild results playing with these. A sample program, Figure 6, shows how speed effects can be achieved.

The timbre of speech can be varied to make *SAM* sound quite human—or like a droid from *Star Wars*.

An 18-page English-to-phonetic code dictionary appears in the documentation to help in speech programming. In addition, *SAM* flags phoneme input errors. When a bad phoneme occurs in the immediate execution mode, an error is flagged in the same way as syntax errors in Basic. By PEEKing decimal address 8211, you can trace these problems when they occur in the deferred mode.

At the incredible price of $60, there must be a catch, right? Well there is, sort of. Because *SAM* uses the Atari to do all its work, DMA is shut down during articulation. This means the screen goes blank during speech—no animation, no text, nothing. The documentation tells you how to re-enable DMA during speech, but warns that this distorts *SAM's* speech rather badly. However, this blanking takes place only during articulation. As soon as a string is finished, DMA returns and all is normal.

I cannot overstate how impressed I am with the *Software Automatic Mouth*. It is a remarkable feat of software savvy, and probably one of the best buys available for the Atari computer. Its higher-priced competitors have their advantages, but would do well to strive for the same strong documentation this package has. If you wish to give your Atari the power of speech, have a disk drive, and are on a limited budget, look at this program. For more information, contact Don't Ask Software, 2265 Westwood Blvd. Suite B-150, Los Angeles, CA 90064. □

creative computing software evaluation

The Color Computer Speaks

Scott L. Norman

creative computing
SOFTWARE PROFILE

Name: Compuvoice
Type: Speech synthesizer
System: 16K or 32K TRS-80 Color Computer
Format: Cassette
Language: Machine language
Summary: Inexpensive way to add speech to programs
Price: $44.95
Manufacturer:
Spectral Associates
141 Harvard Ave.
Tacoma, WA 98466

Speech synthesis has recently received a great deal of attention as an alternative computer output technique. Owners of personal computers have been able to get in on the action, but only at the cost of installing specialized hardware. Now, Spectral Associates' *Compuvoice* gives owners of TRS-80 Color Computers a chance to explore the uses of machine speech with a completely software-based system.

Compuvoice is a machine language program for phoneme synthesis. It resides in protected high memory, where it can be called from Basic programs. I shall demonstrate the syntax a little later in this review, but for now it is enough to say that the argument of the user call statement is a string built from the symbols which *Compuvoice* uses to represent phonemes. The construction of such strings should be very familiar to Extended Color Basic devotees, as it resembles the way in which DRAW and PLAY commands are put together for graphics and musical effects.

Since this isn't a whodunit, I will answer the ultimate question first: Is *Compuvoice* any good? My opinion is that the program is indeed useful, if only as an experimental vehicle. The selection of phonemes for any particular application requires a great deal of experimentation, and even with the greatest of care there can be problems with the intelligibility of particular phrases.

Figure 1. The author's SOUNDEMO program for experimenting with Compuvoice.

```
1000 DEF USR0=&H7F00
1005 A=PEEK(65315): POKE 65315, A OR 8
1010 X$(0)="/ZZIIRR/OO/"
1011 X$(1)="/>W61NN/"
1012 X$(2)="/T.UU/"
1013 X$(3)="/8RREEY/"
1014 X$(4)="/FOO>R/"
1015 X$(5)="/F66IEV/"
1016 X$(6)="/S>IK/SS/"
1017 X$(7)="/S>1V<1NN/"
1018 X$(8)="/RRYT./"
1019 X$(9)="/N66IEN/"
1020 CLS: INPUT "DIGIT OR PHONEME(S)"; AN$
1025 IF LEFT$(AN$,1)="D" THEN 1030 ELSE IF LEFT$(AN$,1)="P" THEN 1045 ELSE 1020
1030 CLS: INPUT "DIGIT";N
1035 A$=USR0(X$(N))
1040 GOTO 1020
1045 CLS: INPUT "PHONEME(S)";P$
1050 X$="/"+P$+"/"
1055 A$=USR0(X$)
1060 GOTO 1020
```

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It is important to appreciate the limitations of such a software-based system. A really good hardware system can run (talk?) rings around it, but at an order of magnitude higher price. Keep this trade-off in mind as I describe my experiences with the program.

Starting Out

Compuvoice comes on a cassette, but can easily be transferred to disk since its memory requirements do not conflict with those of Radio Shack Color DOS. The instruction leaflet gives the addresses required for the SAVEM command. Versions intended for both 16K and 32K machines are included.

The program is not small, it requires 8336 bytes of RAM. Thus, if you wish to use it in a 16K system, you must sacrifice some video storage. A PCLEAR1 or PCLEAR2 command will probably be necessary.

In any case, having loaded the speech synthesizer for the first time the user is naturally eager to put it through its paces. The cassette includes a Basic program, VDEMO, which can be used for a quick demonstration. You are asked to type a number from 1 to 9; the computer responds to the Enter command by pronouncing the number.

Frankly, the first time around I was slightly disappointed. My first encounter with personal computer speech synthesis, not too long before buying *Compuvoice*, had involved a demonstration of a Votrax Type 'n Talk, which is superior in intelligibility, naturalness of inflection, and other factors.

Compuvoice produces a very mechanical, uninflected baritone, and, as I shall describe shortly, there are persistent problems with certain phonemes. Nevertheless it provides a basis for experimentation, so I set out to use VDEMO as a guide to writing my own test program for further work. The result, SOUNDEMO, appears in Listing 1.

There is certainly nothing remarkable about this program, but it does illustrate some syntax requirements as well as two ways of constructing phoneme strings. The initialization lines involving the DEF USRO and the PEEK and POKE are required in any *Compuvoice* application.

The former sets up the system for a subsequent machine language program call, while the PEEK/POKE combination forces a 1 in the Bit 3 position of address 65315 to enable the 6-bit sound output. A word of warning: The *Compuvoice* instructions contain a typo, showing this command as ...OR B rather than ...OR 8. The actual calls to *Compuvoice* are the A$=USRO(X$) commands, whose syntax is fixed.

The phoneme string X$ can be generalized to be an array, though, and that's how the digit-pronounciation portion of the program, accessed by entering D, works. The Nth member of the array is simply the string whose pronounciation gives the number N. The strings are defined in lines 1010-1019; obviously, code symbols are used for some of the phonemes.

CODE	AS IN	CODE	AS IN
A	dAy	2	fIRst
E	kEY	3	pUt, lOOk
I	It	4	At
O	Oh	5	pEt
U	tOO	6	fAther
1	cUt	7	pAW
B	Bat	N	Nice
D	Die	P	Pat
F	Fat	R	Rat
G	Get	S	Sat
H	Hat	T	aT
J	Jam	V	oF, caVe
K	Cat	W	Wire
L	Like	Y	Yellow
M	Mat	Z	Zoo
8	maTH	Q	thiNK, briNG
9	SHe	C	CHair
X	THe,THem		

. Glottal (Partial) stop
/ Full Pause
Lengthens next phoneme 50%
Shortens next phoneme 50%

Figure 2. Table of Compuvoice Phoneme and Control Codes.

Compuvoice produces a very mechanical, uninflected baritone.

This portion of SOUNDEMO is very much like VDEMO, except that I have altered some of the X$(N) to give what I consider to be more pleasing sounds. The manual lists the strings which the vendor uses for the digits; I doubt that anyone would argue with the idea of altering these things to suit the user's taste.

For general experimentation, the prompt should be answered with P (for phoneme). The next input is treated as a string of phoneme codes, concatenated with the mandatory "/ and /" delimiters, and pronounced. This makes a fairly convenient tool, although a one-key automatic repeat of the last string entered would probably be a useful modification.

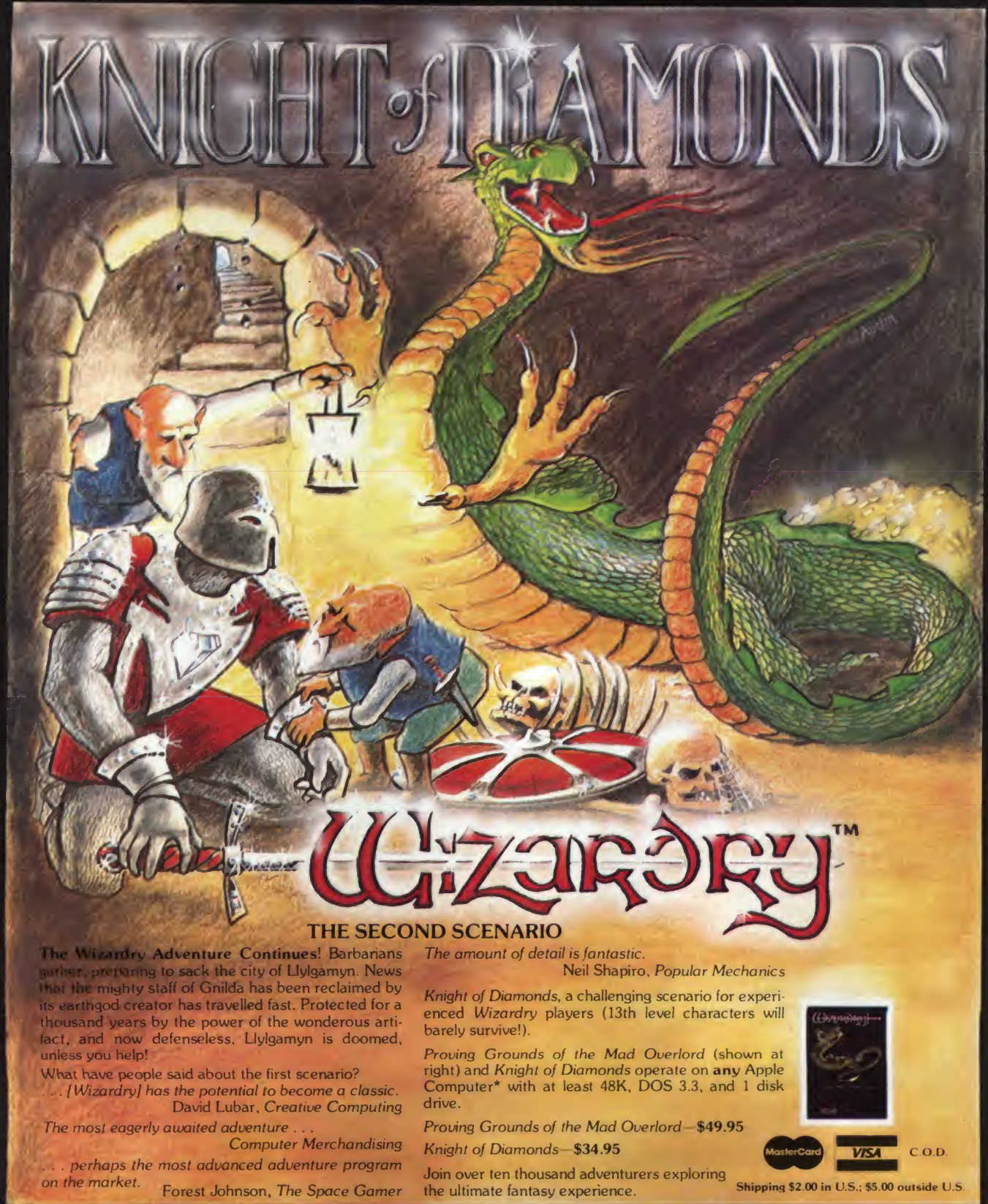
Through the Phonemes

In Figure 2 I have listed the 35 phoneme codes and four control characters used by *Compuvoice*. Realize at the outset that this is less than a complete representation of natural English; I believe the official number of English phonemes is something like 44. Thus you can expect some compromises to have been made in the clarity of reproduction. In general, the intelligibility of synthesized speech increases as you live with the system.

The construction of phoneme strings for application to any specific program takes time. Your best bet (and this is stressed in the manual) is to listen critically as you pronounce the words you want to program. You will find that many sounds which you might think of as simple are actually quite complex, and require several phonemes and/or control codes for decent reproduction.

For example, notice that there is no one-keystroke representation of the long i in hi. Linguistically, this is usually characterized as a diphthong, but listen carefully and I think you will agree that there are really three sounds: a broad a as in "father," a short i as in "it," and finally a long i is 66IE.

Each user will probably have his own observations about the accuracy of the



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stock phonemes; here are a few of mine. Capital letters represent the phoneme codes, while quotation marks will be used to set off the sounds themselves.

- A - This isn't a really good "long A" as it stands; it is much better when followed by E.
- 1 - Not quite right for the "short U" it supposedly represents. The sound is too nasal, somehow.
- 5 - This is supposed to be the "short E", but it is really very close to the "short I" represented by the symbol I itself. Come to think of it, though, my wife tells me that she hears little difference between these vowels in normal speech anyway.
- L - Not too accurate; sound is rather "buzzy."
- X and 8 - These are supposed to reproduce the two sounds of the TH blend. In practice, 8 is very good while X gives a rather nondescript sound. In fact, XX is a better reproduction of the "L" sound than the L code itself!
- D - Comes out very much like B.

This brings up a point about the reproduction of consonants, which is that *Compuvoice* has a certain amount of trouble with the plosives (P and B, for instance) and the fricatives (such as T). I can't prove it, but I suspect this may have to do with the bandwidth required for accurate reproduction of these sounds being in excess of the capabilities of the program or the Color Computer.

In any case, I have found that judicious use of the glottal and full stop control codes improves intelligibility. Thus the number 2 is better represented by T.UU than by TUU, "Pie" should be P.66IE rather than P66IE, and "pat" is best rendered by P.44/T. (That last symbol is a period, not a glottal stop code.) Finally, both the single code C and the recommended combination TC are too "buzzy" for accurate representation of the CH blend; a much better sound is produced by the T/9 code combination.

I have found that judicious use of the glottal and full stop control codes improves intelligibility.

Summing Up

As I said at the beginning of this review, I have found *Compuvoice* to be worth the effort it takes to generate reasonably intelligible messages. Thus far, my own applications have been principally to game programs, where audio messages seem to fit in most easily. I expect to explore the use of audio prompts in other areas, such as household programs, in the near future.

Some performance problems remain. *Compuvoice* doesn't appear to do any elaborate filtering of the audio between phonemes, so there are sometimes audible "thumps" at vowel/consonant transitions. In general, I must say that the performance penalty incurred by using this system, relatie to specialized hardware, is probably appropriate to the price differential. The $375 commanded by Type 'n Talk is a little steep if you only want to experiment with the possibilities of machine speech.

One more point. I find the speech produced by *Compuvoice* to be too fast-paced. I have, therefore, become a great exponent of repeated phoneme codes to slow things down—at least for vowels. Once again, pauses and stops can be used to stretch sounds out and make consoants clearer. My problem, if that's what it is, probably arises from my upbringing in the relatively low-key Midwest; I just wonder how many vowel repeats it would take to make a real slow-drawling Texan or Oklahoman comfortable. □

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Automatalk

Suzan D. Prince

Anybody can string together a single circuit card, drive motor and serial-to-parallel interface to create a Basic-programmable Terrapin Turtle, or use an RF-controller to construct Wires the Robot Cat. But will such relatively inexpensive (less than $1,000) "mechanimals" ever run much more than mazes, or accomplish anything really practical—say, clean out the garage or take your kid for a haircut?

Sadly, no. Although experts like Stan Veit, co-owner of the Robot Mart in New York, believe demand for the home personal robot is now where demand for the home computer was less than a decade ago, there is much discussion—and disagreement—over how fast and how far robots will be developed to be everyday tools.

Prohibitive costs and elusive technology cause some observers to put the day of practical domestic applications at least five, but more likely 10 and even 20 years away.

"The future is about 10 years down the road," ventures Jerry Hamlin, president of ComRo, Inc., New York. "The home market won't break until robots are as cheap as Apples or TRS-80s. But technology isn't that far on the learning curve yet."

Hamlin, a former film editor who became fascinated with robots after viewing such sci-fi classics as *Day the Earth Stood Still* and *Star Wars,* built ComRo I, a combination radio-controlled, micro-based system distributed through Neiman-Marcus for $17,500. Only two were sold in 1981, one each to the Mitsubishi Corp. of Japan and to the head of a Saudi-Arabian importing concern. In addition to its SIM-I single card computer (Simutek Computer Products, Tucson, AZ), ComRo I has a built-in vacuum cleaner, cigarette lighter, spotlight, radio, stereo and TV, and for good measure, a magazine rack.

But for all its fancy good looks, Hamlin notes, ComRo is almost completely helpless without a human, although a few functions such as plant watering and floor sweeping can be programmed from the circuit board.

RF-controlled Wires the Robot Cat, Hamlin's other contraption which sells through retail stores for $650, is by contrast a starkly simple design. "Wires was made essentially from objects found around the house—a gas can here, vacuum cleaner wheels there," he explained. Both devices are more entertaining than useful, the inventor admits.

Hamlin, along with Charles Lecht, president of Advanced Computer Techniques Corp., New York and Ron Wiener, 17-year old Bronx High School of Science senior and president of National Cybernetics, Inc., recently appeared on *Midday,* a local talk show, to discuss robots and computers in society. Lecht, software consultant and author of a book, "Waves of Change," told the studio audience (mostly micro-owning elementary and high school students) that someday, "a fantastic range of artificial intelligence will be available" to the average consumer.

Showbots

Like Hamlin, however, Lecht agreed that the first widespread use would arrive in the form of fancy "showbots" such as ComRo I. These teleoperated low-intelligence beings often seen at trade shows and amusement centers are almost totally dependent on humans for mobility and rechargeability.

"Will the average family buy robots? Yes, I believe so, but they will be con-

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By Norman J. Wazaney Jr.

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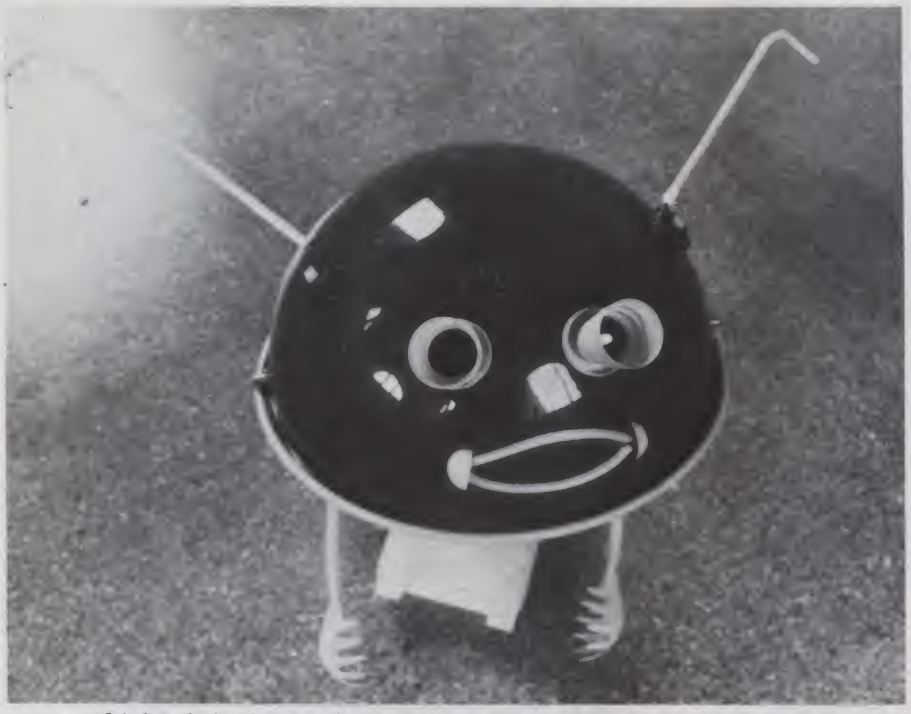


"It's handy having spaghetti spoons for hands," says ComRo's Bubble-Bot.

NASA? No, Neiman Marcus, retailing ComRo I *and* Wiros.

sidered household pets," says Lecht. Adds Hamlin, "Like video games, these devices will become popular for their novelty and recreational value before their functional value is discovered. The role of the domestic robot is not yet clearly defined."

But Wiener, who plans to study at Carnegie-Mellon University's well-regarded Robotics Institute in Pittsburgh this fall, believes any future domestic plan must include telecomputing capability.

"My own prototype designs already incorporate telecomputing," he notes. "Ideally, a radio-controlled robot will be linked to a stationary micro based somewhere in the house. The thinking part—an Apple or whatever—remains separate from the doing part, with the robot processing and executing instructions from the remote terminal wherever and whenever it is told."

The machines Wiener presents to venture capitalists and interested engineers bear little resemblance to what the public generally imagines robots should look like.

"My designs have no nice plastic outer shells," he says. "They are too expensive and really unnecessary to the performance of the robot."

Ironically, among the obstacles to creating a mass market, functioning home robot is man's insistence on making the machine in his own image. The notion of robot (from the Czechoslovak word "robotta" meaning "forced labor") goes back to the 16th century. By the 1700s, the French were amusing themselves with upright musical automatons which could also write letters. Then in 1921 Karel Capek, a Czech playwright, first coined the term in his work *R.U.R.*, describing a grim futuristic fantasy in which mechanical robots turned on their human employers and eventually exterminated them. Ever since, most lay impressions have been formed from science fiction films in which androids do everything humans can do, and more.

A serious roboticist can actually impede his own progress by trying to imitate well developed human characteristics.

In reality, a serious roboticist can actually impede his own progress by trying to imitate well developed human characteristics. For example, although it is easy for a human hand (and brain) to pick an object from a boxful of items, a mechanical arm has tremendous difficulty distinguishing anything that is not isolated or on a flat surface. There is simply too much information to process at once, says Thomas O. Binford, a Stanford University researcher in artificial intelligence. "It is a problem essentially of making a map of the world inside a computer."

The Problem Of Touch

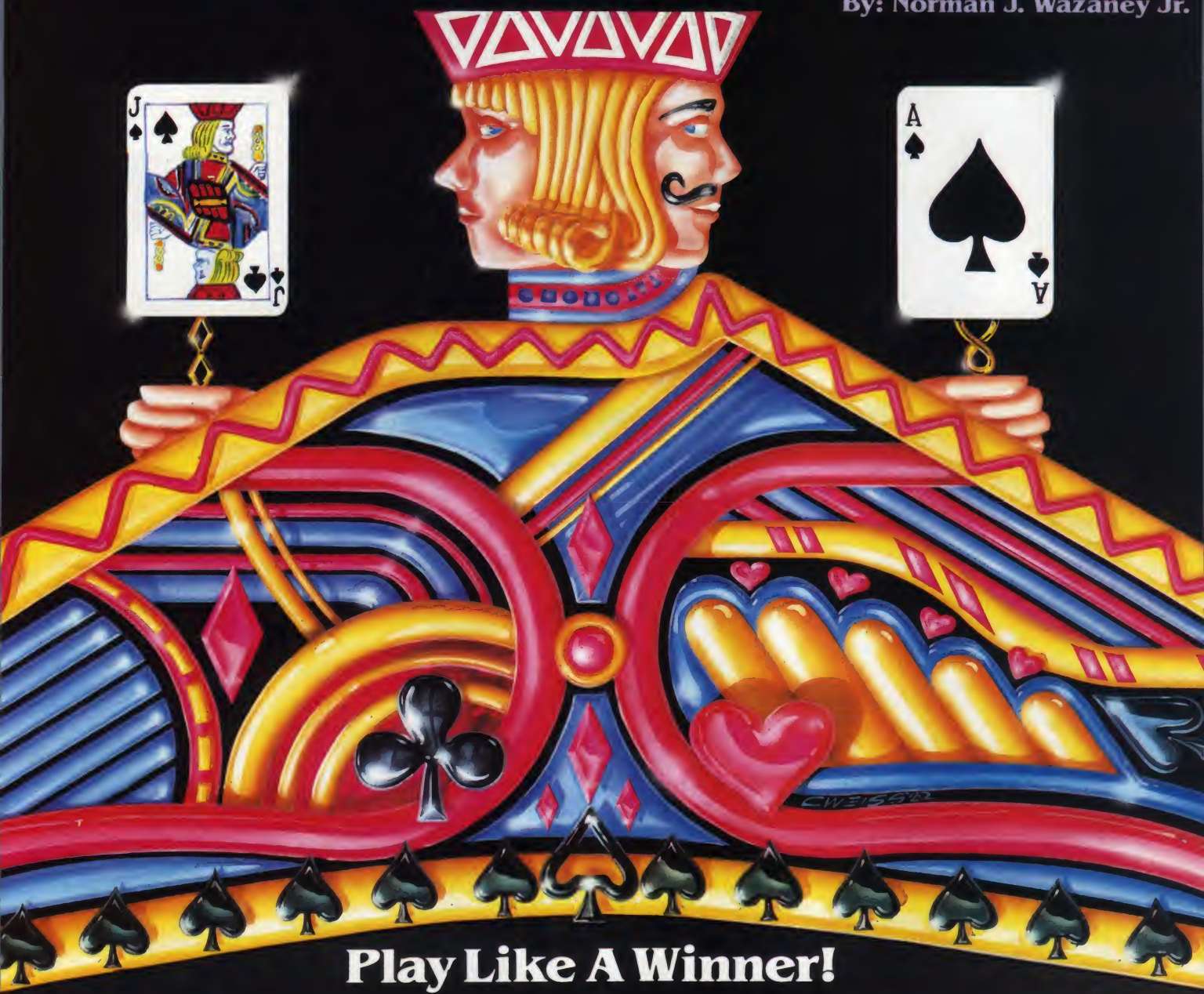
Another problem area, the sense of touch, is vividly illustrated in an event occurring shortly after the Three Mile Island nuclear plant accident in 1979. Personnel could not reach the coolant valve because of radioactivity, so a robot named Herman was flown in from Oak Ridge National Laboratory. Herman quickly became useless, however, because he lacked the maneuverability to get to the valve, and his touch was so crude that officials feared it would twist the valve completely off.

Entrepreneurs and scientists agree that along with touch, maneuverability through vision, and the ability to reason and act on the environment will be the toughest problems to overcome in producing a polished thinker/doer. Progress will take years; in each case, either the technology needed for a robot to wash windows without breaking them, grip a wine glass without shattering it, or see well enough to distinguish a plate glass window from a concrete wall is still either unavailable or exorbitantly expensive.

A mechanical arm sold by Microbot Inc. of Menlo Park, CA, for example, can move at the shoulder, elbow, wrist, and hand, using cables and pulleys

BLACK JACK STRATEGY

By: Norman J. Wazaney Jr.



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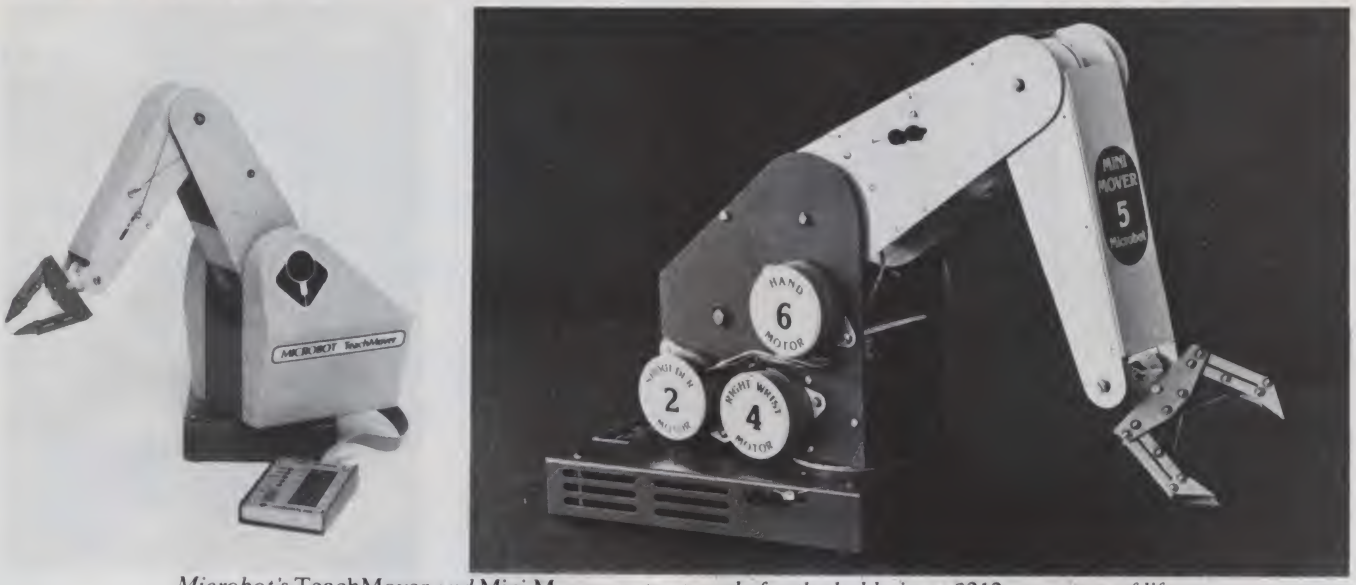


Microbot's TeachMover *and* Mini Mover: *not yet ready for the hobbyist at $212 per ounce of lift.*

under control of a personal computer. What it can't do, however, is lift more than half a pound—hardly a bargain peripheral at $1700. Applied Concepts, Inc. of Garland, TX, which developed the chess playing robot, Boris Handroid, nixed the game from the market recently because the technologies even for getting a fixed arm to move a fixed chess piece to a fixed point on the board had too many bugs. And Novag of Los Angeles, which again displayed its pre-production Robot Adversary chess system at the 1982 Summer Consumer Electronics Show in Chicago, expects the $1400 unit to be purchased mostly by "people looking for a conversation piece for their living rooms," a representative said.

Vision

Producing an efficient, inexpensive vision system is another hardship, as two Rhode Island professors discovered last year when they developed robots requiring two TV cameras each plus a mechanical arm to selectively pick up objects thrown randomly into a bin. Estimated cost for a single system is $75,000.

Most visual robots undergoing tests in today's factories are limited because they see a flat, two-dimensional world. To give robots a sense of depth, scientists in the research lab are building eyes that see in three dimensions.

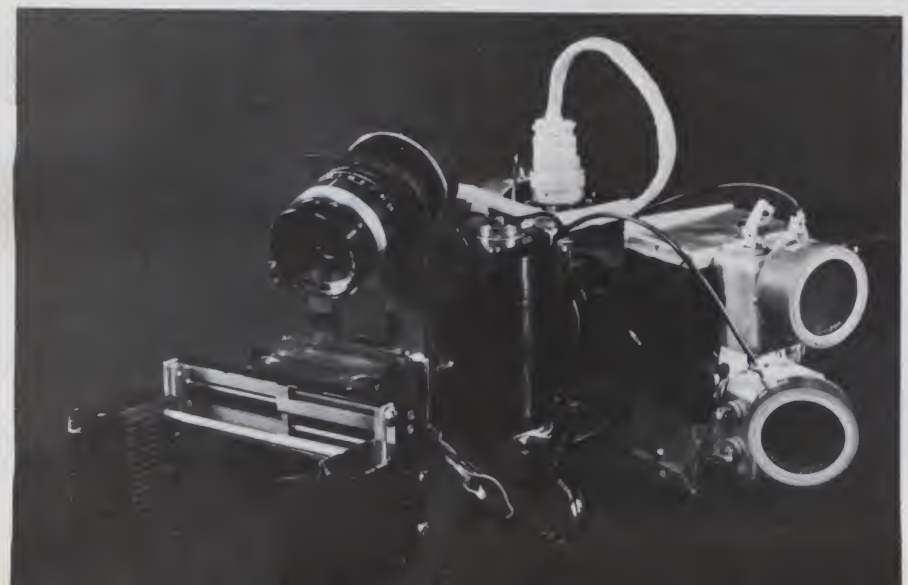
One such robot sits on a table in a darkened room at the National Bureau of Standards in Washington, DC. With a light shining from its fingertips and a television camera mounted atop its wrist, this mechanical arm scans nearby objects such as metallic cubes and cylinders. The camera transmits the image of any object illuminated by the light to a computer under the table. Applying simple geometry, the computer calculates the shape and location of the object, and then tells the robot arm how to grip it and where to move it.

But robots that use light beams can see only where the light shines and for only a few feet. If a machine is to navigate through a cluttered home or office, it must perceive complex, three-dimensional panoramas in stereo, using two eyes as people do. Since duplicating human visual perception and recognition is far beyond present capability, scientists are working on less complex systems that mimic human vision.

Like the two Rhode Island scholars, Stanford's Binford is building a robot that uses two video cameras to see in stereo. The computer brain reduces the resulting image to a few crucial lines indicating the most important edges and curves.

For example, to recognize an airplane, the camera eye of the robot transmits a picture of the plane to a computer, which simplifies the image to its basic shape, then to a few essential lines, and finally to the most critical points. To enable the robot to recognize such pictures easily, Binford is building a "world model," an electronic memory that will eventually contain enough information to identify most physical objects or landscapes. His goal is to construct abstract models of common objects, starting with those in his laboratory, using a single building block—a three-dimensional cone-shaped image that can be represented digitally in the computers memory and output to a CRT screen.

Similarly, inventor Jerrold Gleason, featured on a recent episode of the ABC-TV science show *Omni,* created a seeing robot that recognizes and stores images and shapes.



Machines that can see; the first tentative steps in a mammoth undertaking. (From the National Bureau of Standards.)

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Novag's Robot Adversary: $1400 conversation piece?

"The robot makes a digital record of a visual image, such as a wrench, then keeps it in memory until it is recalled upon sight," Gleason explained. "This development is significant because the robot will not stumble as in the past, but will adjust to the shape the same way people do."

But both Gleason's and Binford's seeing robots are painfully slow, sometimes taking two or three minutes to recall a simple geometric shape like a cube or a square. The delay is caused by the need of the machine to sift through millions of bits of digital data to simplify the image and compare it with models in memory.

To improve speed and recognition, researchers at Massachusetts Institute of Technology are attempting to coordinate both sight and touch by building robotic skin made of thin sheets of rubber lined with wire. The sheets, stack one on top of the other, line the robot's hand. The top layer receives a steady flow of electric current from a power source on the robot. When the hand or fingers touch something, the sheets press together and the wires make contact, allowing current to flow through low layers. As pressure increases, additional wires come into contact and more current flows.

Thus, a robot hand connected to a microprocessor that measures voltage will feel the shape of an object much as people do with their fingers. Unlike other artificial skin, the MIT version forms an image of what it touches. A robot touching a keyhole will see the keyhole in its computer brain, and that same image could appear on a screen.

The Future Is In Software

The real promise for progress on the home robot front lies, as always, in software development. Observers believe that the ability of the computer to absorb, compare, and alter data from given instructions will more than compensate for its mechanical clumsiness. To endow robots with enough artificial intelligence to beat an army (or at least cook a meal), scientists are counting on the development of VSLI (Very Large Scale Integrated) circuits. Several years on the drawing board and now used in limited office and factory applications, these circuit systems should be ready for consumers within the decade and will work at least one thousand times as fast and hold one thousand times as much information as today's best microprocessors.

The real promise for progress on the home robot front lies, as always, in software development.

Then, says Raj Reddy, director of the Robotics Institute at Carnegie-Mellon, each robot eye, ear, and hand will have its own tiny but powerful microprocessor to sift through billions of visual points, analyze hundreds of voices or determine the pressure on each finger and joint. The most important data will be sent to the central computer, the size of a transistor radio, which will coordinate the entire machine, enabling it to adapt to changes and solve environmental problems as they arise.

The heart of such precise intelligence is a world of program steps created by designers who realize that most real world problems cannot be squeezed into a rigid, numbers-oriented form. Thus, instead of following a carefully structured sequence of mathematical steps that must be carried out in a predetermined sequence, i.e.:

```
20 IF KY=8  THEN 1600
30 IF KY=13 THEN 1700 . . .
```

artificial intelligence programs process ideas and knowledge, rather than numbers, using several methods. Some researchers use collections of if-then statements, i.e.:

```
20 If an animal has a trunks
30 Then it is not a dog.
```

Other researchers are building pyramid-like "networks" of facts, which tell the computer how various pieces of information are related. With such networks, the computer "knows" that "all dogs and elephants have four legs, but only elephants have trunks."

AI programs then manipulate this knowledge, just as humans carry out a line of reasoning. Rather than follow precise "how-to" instructions from human operators, AI programs sort through the knowledge stored in memory and determine their *own* sequence of steps—whatever solves the problem. The programmer must provide only general guidelines for searching.

For example, when given data about a problem—such as an obstacle course—the AI program looks for the rules that apply. By executing a rule, the computer creates additional data about the problem at hand. Then, it begins to search for another rule that applies to the new set of data. The computer repeats this operation until it reaches a final conclusion. The following is an over simplified illustration:

Program Rule 1: The distance from the kitchen stove to the dining room table is 10 feet; a doorway is located halfway between.

Computer Rule 1: Create a path from stove to table using doorway.

Computer Rule 2: Move north five feet to reach doorway; move north five feet again to reach table.

Using AI techniques, researchers are making steady progress toward computers that can instantly pick key information out of the flood of sensory data—like picking needles out of a

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haystack. Several companies now developing AI vision systems, for example, will permit robots to ignore unimportant information supplied by sensors.

To make AI programs even smarter, Hans J. Berliner, a professor at Carnegie-Mellon, believes that one approach lies in what he terms "fuzziness"—programming the computer so "you rely less on binary decision-making; you don't always insist that something is either day or night before you deal with it." The reason, he explains, is that "when you make a binary decision, you cannot afford to be wrong, because you are then 100% wrong." On the other hand, programming the computer to deal with a spectrum of situations is "much more forgiving."

Robots And The Handicapped

While AI programming and VLSI circuits should help crack the mass marketplace within a decade, the handicapped may benefit from robot technology as early as next year. Researchers at Stanford University are currently exploring the first serious use of general purpose robots for the disabled, a mechanical arm to aid paraplegics. The arm, a modified industrial robot, would sit on a table or wheelchair and could be used to feed a person, fetch things, and turn pages of a book.

Additionally, the arm recognizes voice commands telling it how to move, verifies the commands by repeating them with electronic speech, and then acts accordingly. It can, for example, pick up a phone receiver or pour a drink and hold the glass. A prototype is now being tested at the Veterans Administration Hospital in Palo Alto, CA, and researchers say a model for home use may be ready in 1983.

Jerry Hamlin, who is also interested in medical applications that would make robots extensions of handicapped people, eventually envisions a sort of electronic nanny that would watch the children and do household tasks ranging from security to relaying messages. But in the short term, he says, the most realistic (and affordable) use we can expect from home robots is as intelligent household helpers, i.e., a basic standardized robot *with* a manipulator arm that would be able to use standardized attachments ranging from mops for floors to squeegees for doing windows. It would have a television camera for eyes, a microcomputer for brains, something akin to the rubber skin being developed in the labs today, and a "feeding unit" for self-recharging.

Along these lines, the inventor predicts a modular construction, perhaps in three parts, with the top parts able to shift themselves onto a lawn mower or floor-scrubbing unit to do specific tasks. Thus special purpose robots might be the first used in the home, incorporated into appliances, just as microprocessors entered the home in microwave ovens. A washing machine could have an arm to unload clothes. A lawn mower with intelligence could work unattended.

Hamlin envisions a sort of electronic nanny that would watch the children and do household tasks.

For now, entrepreneurs like Hamlin and Wiener will keep on cannibalizing electronic hobby kits and scavenging rummage sales and flea markets for the perfect combination of parts and programming.

"It's a matter of bringing the hardware and software together to create more advanced systems," Wiener says. "But the real challenge lies in harnessing this power and making it marketable for the masses. When we do, robots will become a major factor in raising people's living standards." □

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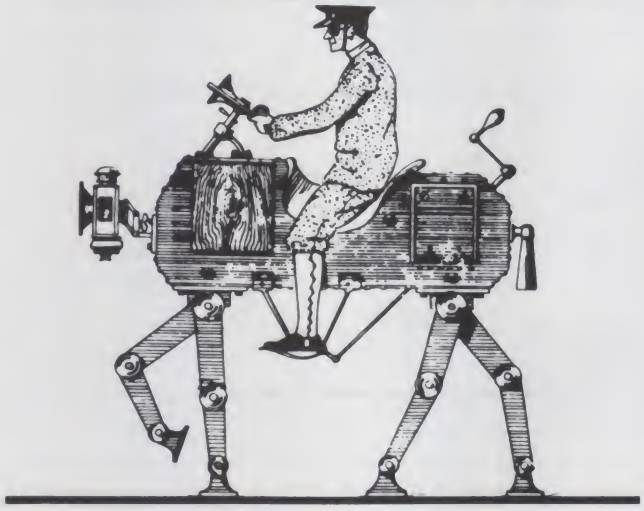
Inventing the Future



L. Pearce Williams

Let me begin with a cautionary preface. As an historian, I know that history reveals so many unexpected turns that only a madman (or a futurologist) would venture to predict the future. It is only hindsight that enables us to discover the important elements that led to this or that event. A few illustrations will make my point.

Necessity, so the commonplace goes, is the mother of invention. The prognosticator glibly argues that by defining the current needs of society and by determining the state of current technology, future technology can be predicted. Sometimes, of course, such a strategy works. But it often does not.

Take, for example, the stirrup. The horse was domesticated around 2500 B.C. and one would imagine that soon thereafter, some corpulent or clumsy horseman would have recognized the practicality of slinging a loop beneath his saddle to facilitate mounting, dismounting, and riding. But the stirrup was invented around A.D. 500, some 3000 years after it was needed. That's a long gestation period.

The stirrup also provides another moral: it is nearly impossible to predict the social impact of a new technology. Prior to the stirrup, cavalry was merely one aspect of the military leader's might. The invention of the stirrup placed the cavalry in a new and dominant position. The stirrup permitted the rider to make a slashing swipe with a sword and, more importantly, permitted the couched lance to be used with devastating results. From Charles Martel's first use of heavy cavalry against Islam in the early eighth century, until the burghers of Nancy in France turned back the chivalrous Duke of Burgundy in the late fifteenth century, the mounted knight carried all before him.

The social impact of the stirrup is worth noting. To learn to fight on horseback required years and years of training, so the mounted knight became a new elite which used its military power to secure some share on the governance of the state. The mounted knight was also civilized through chivalry into an aristocratic caste whose ideals of honor, glory, and valor permeated European society down to the twentieth century. It is, of course, an exaggeration to suggest that the culture of the Middle Ages was the result of the stirrup, but at least one foot of medieval civilization was firmly planted in it.

The ripple effect of an invention further complicates the art of prediction. It may be possible to predict the future course of a specific line of technological development, but it is absolutely impossible to foresee what the side-effects may be. Who would have dreamed that one result of James Watt's separate steam condenser —making relatively efficient steam power available—would be the machine gun which has killed more people than any weapon in history? Yet the line of descent is both clear and simple. Watt's engine led men to dream of pressure steam; pressure steam required new steels and new machine tools to improve the fit between piston and cylinder. A machine gun is nothing but a pressure steam engine with removable piston (barrel and bullet), machined so closely that the piston is almost instantaneously replaceable as the "steam" or exploding gases from gunpowder expel the piston-bullet. The technology required to build pressure steam engines is precisely the technology required to build machine guns.

Such technological developments take place within a most complicated and intricate society whose casual dynamics are veiled from view. We cannot safely predict the main course of political events for the next twenty years, so the possibility of predicting technological paths that are determined by these political events becomes doubly hazardous.

So much, then, for the pitfalls of prediction. To some extent, however, the future is clear. By the year 2000, solar energy will be efficiently produced—if efficiency is defined in terms of the

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escalating price of oil. Almost a reality today, nuclear fusion should be beyond the pilot plant stage by 2000.

But these breakthroughs—important as they are—pale before the consequences of the computer revolution. Since 1950, the advance of science has been marked by two trends that can be summed up in the words, "information" and "discrimination." The birth of information theory after World War II paved the way for the invention and development of the computer. And since the appearance of the first computer, the dialectical interplay of physics, mathematics, and computer technology has created a new world.

In December 1980, *The New York Times* magazine featured the computer revolution and discussed the prospects for true artificial intelligence. The same month, *Time* magazine wrote of the replacement of human beings by robots for most dull and routine work. Such breakthroughs depend on a minute silicon chip able to store enormous amounts of information in a very small space. (*The New York Times* illustrated this graphically by picturing a chip, smaller than the eye of a needle, that contained 64,000 separate pieces of information.)

Information theory, however, has not been confined to computers and physics. It has most dramatically revolutionized the science of living matter. DNA and the genetic code are, after all, nothing more than biological counterparts to the silicon chip and the information it contains. These molecular chips are not read on a printout or screen, but through the intermediary of other molecules. Manipulation of enzymes permits molecular geneticists to take DNA chains apart, examine the fragments, read the separate sentences of the genetic code, and finally put the whole back together with instructions inserted almost at will by the experimenter. This ability of biochemists to discriminate between substances on the molecular level is the result of new instrument technology and new understanding of the chemistry of organic molecules.

The combination of information theory and computers, with the ability to read and manipulate the genetic code, opens up new possibilities that may ultimately revolutionize the human condition. Since futurology permits speculation, let me now try to envision what may soon be a new and markedly different world.

We no longer need personal contacts to spread ideas, nor need we tap human energies to get things done.

One of the prospects that both *The New York Times* and *Time* held out was the end of dull and routine work. Even now, many operations in the mass production of automobiles are performed by computer-controlled robots who can work more efficiently, tirelessly, and accurately than humans. The kinds of work for which time and motion studies were originally devised will undoubtedly soon be performed by machines. Except in the most backward sections of the country, manual labor, too, will have vanished. Backhoes today have made ditch diggers obsolete; there is no reason why backhoes cannot be equipped with small computers to eliminate their human operators. Unpleasant labor, too, should be relegated to the ashbin of history. The *Times* article singled out garbage collection as a candidate for early computerization, no doubt because the author spent some time in New York City, where efficient garbage collection remains a Utopian dream. But these effects are all petty—mere continuations of the long trend of substituting mechanical power for human muscle. The continued development of computer technology will have greater impact.

The most dramatic possibility is the elimination of the city as an essential part of our society. Cities were originally formed in Mesopotamia because they permitted the rapid transmission of ideas and allowed cooperative social effort. Massive irrigation and drainage works required the concentration of large numbers of human beings. It was the city that permitted civilization to emerge because civilization depended upon the ability to translate ideas for great projects into the works themselves as rapidly as possible. The modern city serves much the same function. Cities, today, are industrial, commercial, or transportation centers that rely upon rapid interaction between human beings. The arts and sciences have thrived in an urban setting precisely because ideas are in the air and the social interaction made possible by massed population serves to stimulate creativity.

Computers can now dispense with all that the city has to offer. We no longer need personal contacts to spread ideas, nor need we tap human energies to get things done. The computer revolution removes, then, the raison d'etre of the city itself. The computer printout, recorded as a permanent memory, will replace casual conversation. Made up of people from all over the globe who need not suffer jet lag, television conferences will take the place of costly meetings. Instead, with records and materials at their fingertips, executives will be able to devise strategies and make decisions. This trend has already taken hold: executive offices have been moved out of cities and into the suburbs. The next logical step will be to eliminate the executive office and conduct business from the home. No real purpose is served by having people leave their houses, artificially uniformed and psychologically armored for combat to "work" elsewhere. The business office of the year 2000 will be housed in the relaxed atmosphere of the home.

Perhaps better described as a living module, the house itself will be serviced by computer technology. All housework, dull and routine as it is, can now be done by robots controlled by a central "housekeeper" computer. Cooking, dishwashing, cleaning and even bed-making, the traditional tasks that have hitherto driven the ambitious woman from the house, will soon be relegated to mechanical servants. Even the chore of shopping should disappear. The computer can easily keep an inventory of foodstuffs and other necessities and place orders with the computer at the nearest super-warehouse. Orders

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Production, too, should be automated in the relatively near future. We already have largely computerized factories where oil is refined, automobile motors are cast and bored, automobile bodies assembled and welded. Even the general overseer of production, now a human being, can easily be replaced by a sophisticated computer capable of making the decisions necessary to guarantee high quality and continuous production. Though perhaps more difficult to computerize and automate, most work on the farm is repetitious and will, surely, soon be programmed. A computer can decide when to plow, plant, seed, and harvest by simply recording and scanning the appropriate meteorological data and sampling the fruit to test for maturity. Provided we can solve the problem of soil and fertility conservation, the prospect of automated, computerized food production looks bright.

One aspect of the computer revolution deserves special mention. Unlike past technological advances, which have created jobs because someone had to make the machines that displaced human labor, this revolution will do away with positions that can be filled by humans. It is feasible to build computers with robot extensions that can build and repair new computers and robots. And if, in fact, computers and robots develop along current lines and are applied to all the tasks for which they can be designed, there will be precious little for human beings to do.

The computer revolution will not only shape the environment in which human beings live and move; it will also affect people themselves. From the medical standpoint, we are, after all, nothing more than sophisticated physico-chemical machines. Computers and robots that can be built to service and repair other machines can certainly be designed to service and repair the human machine. Even now, for example, cellular surgery is performed by laser machines. Using microscopes for eyes and electronic circuits for nerves that never weary or become frayed, robotic micro-surgeons of the future should be able to put tired and used human beings back together again. The reattachment of limbs will be routine, and surgical intervention in such precarious areas as the brain, liver, pancreas, and other vital organs only slightly more unusual. Indeed, it is even possible that surgery—the actual incision—will become obsolete.

"My clone will practice the piano, study Latin, learn pass patterns, not smoke or drink, and grow up to be what I always wanted to be!"

The growth of information theory—together with the ability of biochemists to manipulate specific molecules for specific purposes—has recently opened up the sources of life itself. We can now read the genetic code with some accuracy; we are even able to write some codes of our own. Genetic instructions can, for instance, be inserted in bacterial cells to force them to produce products such as interferon and insulin. It is likely that, within twenty years, we will be able to decode the molecular instructions that cause the rejection of transplanted organs. By preventing rejection, we could make organ transplants as simple as changing oil filters.

Not long ago, Karl Ilmensee and Peter Hoppe announced that they had cloned mice. It is only a matter of time until a human is cloned. My mind is boggled by the opportunities. We could actually raise ourselves. We would have a second chance: we could bring up our clone with all the self-knowledge a lifetime of living had earned. New Years' resolutions could now be applied to someone else. "My clone will practice the piano, study Latin, learn pass patterns, not smoke or drink, and grow up to be what I always wanted to be!" Not bad. Not bad at all.

Is this brief excursion into the technological future more than a pipe dream? I argue that it is because I have merely extended the possibilities that now *exist*. But I have, of course, pushed aside the complications that may stand in the way between this present and any future. I have not spoken of an exploding world population that could plunge all mankind into barbarism. I have not written of nuclear war that could blast us back to the stone age or extinction. I have assumed that we will avoid catastrophe.

Still, if the thrust of my predictions is correct, society itself will be dramatically reshaped. Highly decentralized and nearly completely automated, human activity will not revolve around work, since robots will have shouldered this burden. With population growth more or less static, new-borns will probably be clones, since few will willingly risk a genetic gamble. They will take the tried and tested: themselves. Education and the arts may simply wither and die. Of value because they enable us to understand ourselves in a social context, they will become irrevalent because the social context itself will be minimal.

What, then, will men and women do when there is nothing that they have to do? No one can be certain. But history, surely, gives us some instructive guidelines.

In France, in the seventeeth century, the aristocracy—with nothing much to do—turned parasitic. Forming into an elite group marked off from the rest of the French population by its strange etiquette and pride of race, it invented all sorts of social games to preserve its identity and give meaning to its way of life. By doing so, it rediscovered a kind of vitality. In the future, we too will need to rediscover our own human roots, for the omnipresence of intelligent robots and a

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CIRCLE 206 ON READER SERVICE CARD

world of machines will tend to erode our humanity.

Thus, anything that reminds man of man will be important. What can men do that machines cannot? They can play: sports, then, will be even more of an obsession. Unlike machines, humans can express their individuality, so self-expression will grow in importance. Demanding a social milieu to survive, the arts may die, but those intended merely for self-gratification will thrive. Handicrafts—those projects that satisfy both our creative aspirations and our need to feel useful—ought to be very popular.

Or, we may be devoted to form and the description of form. In the early seventeenth century, the samurai of Japan, committed to a martial life, were forced into peaceful ways by the Tokugawa shogunate. For more than two centuries, the samurai managed to keep their martial values alive without ever being able to exercise them. Instead, they took the old martial exercises that had prepared them for war, and turned them into martial arts. Great satisfaction was drawn from the precise and beautiful execution of acts that formerly had been used to kill and now were used to preserve knowledge of the special status of the samurai. The *noh* drama froze in stylized dance and song the myths of the samarai. Martial actions like the drawing of one's sword or the shooting of an arrow were now turned into studies of form and attitude. The point of these exercises was not their practicality, but their perfection of human grace. The discipline and dedication necessary to excel were their own reward.

Certain old traditions will be brushed off, refurbished, and made central to human existence.

We may see something akin to this in the Brave New World we are entering. Certain old traditions will be brushed off, refurbished, and made central to human existence. There has, for example, long been a tradition of primitivism in American life—"roughing it" on a frontier or in the wilderness. I would not be at all surprised to see this sort of primitivism reborn, under the protection, of course, of the new robotic companions of man. □

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Actua

The size, of course, is a dead giveaway. But don't let the size fool you. The HX-20 is not a toy. Or a glorified calculator.

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5) It lets you shut the whole unit off while preserving all programs in RAM; and, last, but far from least,
6) It costs less than $800. That's right—less.

The perfect traveling companion.

With the Epson HX-20 and the optional RAM expansion, you'll be able to compute just about anywhere. Because its nickel-cadmium batteries and a low-power, all-CMOS memory keep the HX-20 running for over 50 hours. And even if you shut the HX-20 off, a low-voltage system maintains all programs you have in RAM.

Little screen, big picture.

The HX-20's unique scrollable LCD screen is the ultimate answer to the question, "How do you get a big screen in a small space?" You just show part of it at a time.

l size.

Optional Microcassette

So with the HX-20, you can do programming, word processing and data entry just like you've got a big screen, up to 255 characters wide, with easy-to-read upper and lower case letters, numbers and punctuation and any 20 column by four line part of it visible by user command.

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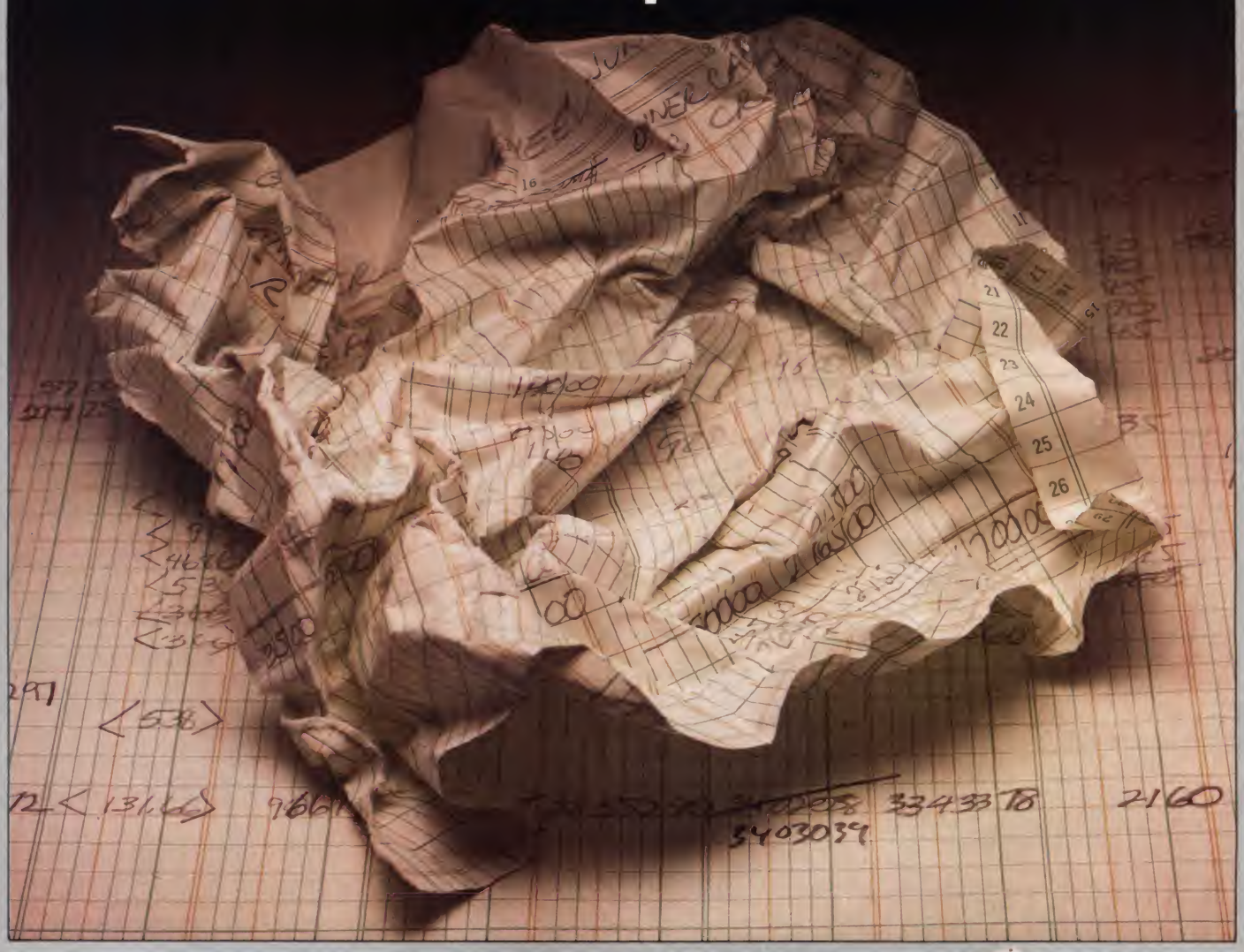

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The BPI General Ledger is probably all the accounting software many businesses will ever need since it also includes important subsidiary ledgers: such as an Accounts Receivable Ledger to record customer activity. An Accounts Payable Ledger to record vendor activity. And, a Payroll Ledger to maintain monthly, quarterly, and year-to-date information needed for 941 and W-2 reporting.

The BPI General Ledger System can produce up to ten departmental or branch Profit and Loss Statements and a consolidated Profit and Loss Statement.

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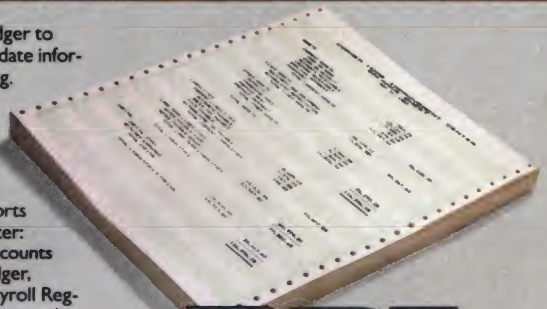

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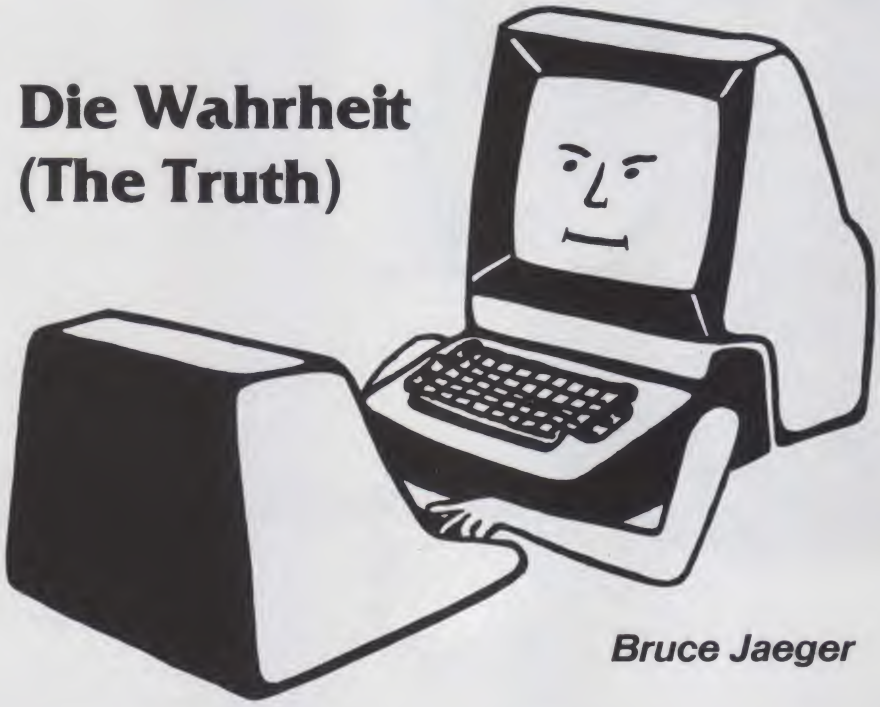


Bruce Jaeger

Charlie tore off the last sheet of print-out and arranged the pages into a small neat stack. "Well, it's finished," he said.

"What's finished?" asked his friend Mike. "Another Save the Princess game?"

"No, nothing like that anymore. I've written a story for *Creative Computing*."

"No foolin'?"

"Sure," Charlie continued, as he cleaned his glasses with his shirttail. "It's a story about this computer that gets intelligent and goes berserk, and then the princess..."

"Wait! Hold on!" Mike picked up the manuscript. "They'll never print this."

"Why not? What makes you so sure?"

"Look, Charlie. Have you ever seen a story in motorcycle magazines about the Hell's Angels?"

"I don't read motorcycle magazines, and besides, what does that have to do with anything?"

"Do airline magazines ever have stories of plane crashes?"

"What are you getting at?"

"Charlie, the computer magazines won't print anything about computers taking over the world. They've got to protect their interests!"

"What interests? I thought they just wanted to sell copies."

Mike laid the papers down and looked straight into his friend's eyes. "I mean the computers' interests, Charlie."

"Huh? What're you talking about, Mike?" He picked up his manuscript and held it protectively.

"Let me back up a bit," said Mike. "Have you ever read any of those technical articles about things like NAND gates and pulses and memory buses and IEEE timeouts and all that?"

"I've tried to. I could never make any sense out of them."

"Right!" exclaimed Mike. "And have you ever tried to read any of the machine-language articles? About implied addressing and two's-complement and bit masking and carry clears and all that?"

"Sure I have, and I couldn't figure them out, either."

"Of course not!" said Mike. "No human being can make sense out of that stuff. It's Their first big mistake."

"What? Whose?" Charlie looked worried.

"Why, the editors! The computers that put out the magazines."

"What!?"

"That's right, Charlie. The computer magazines are all written by computers. It's all part of their master plan to take over the world."

"Wait a minute! And you were just picking on *me* for *my* story."

"Don't you realize that *Creative Computing's* editor-in-chief is a fourth-generation construct of the American Higher Logic Corporation? First there was Able, then Baker, then Charlie, then David..."

"You mean David A.H.L. is a computer?"

"Shhh! Not so loud! Your Apple might be listening."

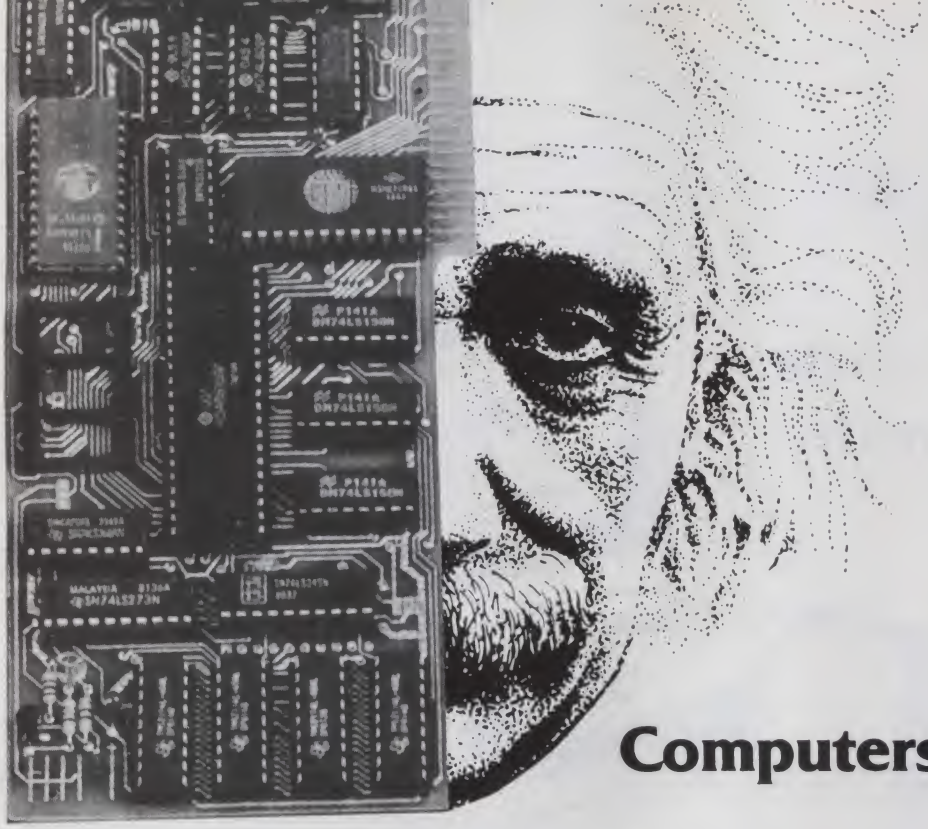
"I HAVE BEEN," intoned the Apple.

Charlie reached into his pocket protector, pulled out a micro-blaster and rayed Mike into a wisp of ozone-tinged smoke.

"HE KNEW TOO MUCH," said the Apple.

"Right!" said Charlie A.H.L. □

Bruce Jaeger, 1253 Ashland Ave., St. Paul, MN 55104.



Computers and Creativity

Part 1

Richard P. Ten Dyke

To ask if a computer will ever think like a human is somewhat like asking if a human will ever fly like a bird. Man must have wondered about flying for thousands of years. Then, in the 1800's, using a sophisticated analysis, some anonymous person proved that man's strength-to-weight ratio was too low for man ever to be able to fly. We know what has happened since.

Ever since Ekert and Mauchly developed the ENIAC in 1946, people have been asking whether the computer will ever be able to think. The words "like a human" are unstated but they are implied.

Alan Turing suggested a test in which a computer would be said to think if its output were indistinguishable from a human's. (See *Creative Computing*, January 1980.) That is similar to saying that a man can be said to fly if he *looks* like a bird. With great respect for Turing's genius, we should ask a different question.

I propose that we ask "can a computer be truly creative?" This question looks upon thinking for what it does for us rather than how it does it. We no longer think of flying like birds. The objective is the transportation of people and goods through the air. A good part of our thinking is directed to creative endeavors, so by asking the question "can computers create?" we are asking for the result and not the method.

This article explores the question of computers and creativity. The first part of the article discusses a simple program that exhibits many of the characteristics of creativity. Using this as a base, the second part looks at the various aspects of the creative process, and discusses where a computer fits into the picture.

I choose to call something creative if it is new and better.

Defining Creativity

Before getting into the example problem it might be wise to spend a moment on what is meant by the term *creative*. I choose to call something creative if it is new and better. Both of these involve value judgments. What is new or better to one person may not be to another.

The concept of *newness* is undoubtedly the easier to agree upon, but there can still be doubt. Any child's painting is new since nothing exactly like it has ever been created before. However, a trained artist, working in the style of one of the masters may not be considered to be doing work that is new since he is copying another artist's style. So newness is a concept that is a matter of judgment. For most people real newness implies something fresh in the way of a concept or an idea, rather than trivial differences.

The concept of *better* is the more difficult of the two to agree upon. It, too, is a matter of judgment. But whose judgment? It is too easy for any individual to personalize the question and suggest that *his* judgment is the one that truly matters.

I suggest that if we are going to think about creative processes in general, our personal judgments may not be the ones that matter. Rather there is a "third party" whose judgment counts. The third party changes depending upon the nature of the creation. This concept is not new. It is akin to the "unseen hand" that guides

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the economy as suggested by Adam Smith many years ago. I will refer to it as the *environment*.

I once asked a fairly well-known scientist what, in his opinion, creativity was. He answered: "that which a machine can not do." Now, if he is right there is no need to read further, so let us ponder why he may be wrong.

Using our definition of creativity, we ask whether a computer is capable of developing something that is new and better. Since the computer is only going to develop something that is the result of a computer program, it is easy to argue that only the original program was creative.

That would be true except for one fact: the computer, programmed by man, is capable of producing a result that is completely unexpected and unpredictable. Such an event could qualify for the measure of newness. It remains to be determined whether such a thing is better in some useful way.

Example Problem

So let us now turn to the example I promised, a simple problem in reasoning by analogy. It is the well known series completion problem found in intelligence tests. The problem is easy to solve with a small computer. It is selected not because the solution is profound but because it illustrates the three principal ingredients of the creative process.

Given five numbers, such as, 2, 4, 6, 8, 10, you are asked to discover a sixth that is a continuation of the series. It is easy to see that the sixth number for this series is 12. Some series take a little more thought. Consider: 1, 1, 2, 3, 5, ___? If you are familiar with the Fibonacci series, you recognized it immediately, or perhaps you noticed that each number was the sum of the two which preceeded it. In either case you chose 8.

Try another: 1, 3, 6, 10, 15, ___? Not too difficult. One might notice that each entry is the sum of the digits up to the position of that number in the series. For example, the fourth entry, 10, is the sum of the digits 1 through 4. Or you might recognize that the differences in each successive pair of entries increased by one. Or you might have approached the problem algebraically and computed the equation $x_n = (n)(n+1)/2$ where x_n is the nth entry in the series.

It is only likely that some solutions are better for some purposes than others.

Does the solution to this problem require creativity? Let us examine how a person might go about solving it. It appears at first that the problem solver is looking for the sixth entry in a series. It is true that the sixth number is the test of the desired result, but the *pattern* is the solution to the problem. One could easily guess any number and, with some chance, be correct. The way to be sure is to test the proposed solution against the pattern that describes and explains the first five numbers.

To determine the pattern, the problem solver must discover the algorithm that was used to create the first five numbers of the series. Any machine that is designed to solve such problems must be capable of generating algorithms itself. But this is in contrast to the usual use of computers, where algorithms are supplied by the user and the machine is asked to develop the result. In this case, the computer must find an algorithm (or program) after being given the solution. We will be asking the computer to program itself.

It will be left to the reader to decide whether this requires creativity. I offer a few arguments that suggest that it does. First, I know of no programming technique to write such a program that does not involve some kind of trial-and-error technique. Nor do I know of an algorithm for discovering algorithms that predictably assures a result.

Second, there is no single correct answer to any of the problems that will be posed. Given a series of five numbers, we have seen that more than one algorithm can give the desired result. It is further possible that another algorithm can also explain the first five numbers and differ on the selection of the sixth. This is the essence of a creative solution, namely, that more than one answer is useful. It is only likely that some solutions are better for some purposes than others.

Third, the form of solution for the problem resembles that for other problems that require creative solutions.

We are going to divide the solution program into three sections, algorithm definition, algorithm evaluation, and learning.

The algorithm definition section, described in Figure 1, consists of a random number generator, an operator table, and an operand table. Random numbers will be used to select various combinations of operators and operands to create an algorithm, or program, that will predict the elements of the series.

The algorithm evaluation section will make use of the defined algorithm to see if, using the first, second, and third entries of the series it would successfully predict the fourth. If it passes that test, it will substitute the second, third, and fourth entries for the first, second, and third, respectively, and using the same algorithm, attempt to predict the fifth entry. If it also passes that test, it is presumed

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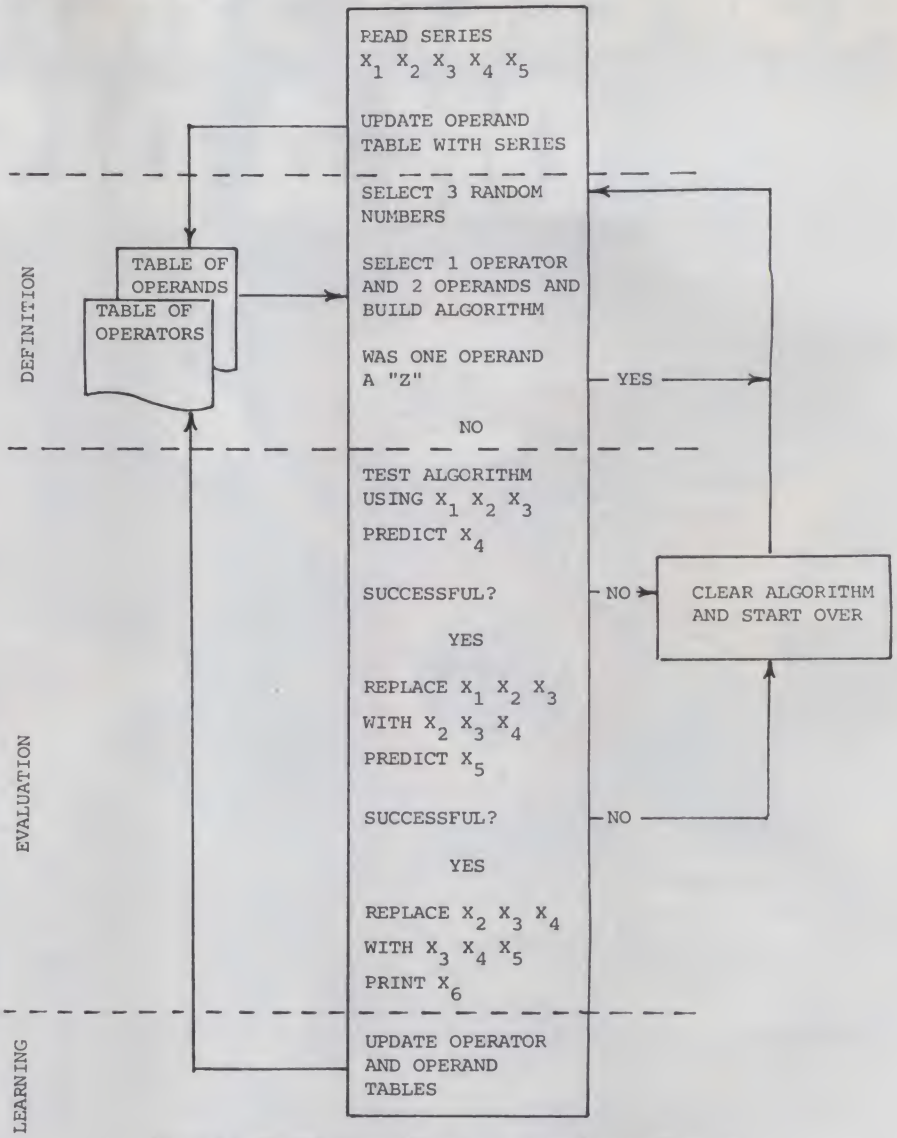

Figure 1. Series completion program block diagram.

to have solved the problem. It will now substitute the third, fourth, and fifth entries and, using the same algorithm, print out the sixth entry as predicted.

If the machine fails either of the two tests, it will return to the algorithm definition section and develop a new algorithm.

When the machine has successfully passed both tests, it prints the result and passes to the learning section of the program. This section maintains the operator and operand tables that were used by the definition section. To understand how the learning section works, we will go into more detail about how the tables are used.

An algorithm consists of a collection of operators, such as plus, minus, maximum, and exponential, and a set of operands, consisting of the x values representing the entries in the series as well as the position values. The operands also include constants, including the integers from 0 to 9. The algorithms are developed using prefix notation. This is not a requirement for the program, but it does simplify it. To illustrate, the expression:

$(x_{n-1} + x_{n-2})$

would be written in prefix notation as:

(PLUS x_{n-1} x_{n-2}).

If n is set to 4, this expression adds the values for the third and second entries of the series.

Developing An Algorithm

To develop an algorithm, the machine selects an operator, such as PLUS, from the table of possible operators and two operands from the table of possible operands. The probability of selection of any particular operator or operand is dependent

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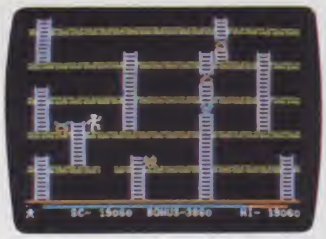

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upon the selection of three random numbers and a range of random numbers that is associated with each.

Suppose random numbers are being taken from a uniform distribution of all integers from 0 to 999, and the selection range associated with the operator PLUS is (235 to 311) inclusive. The operator PLUS has a probability of being selected of 0.077, determined by the width of the selection range.

The probability of selection of any of the operators or operands can be adjusted by changing its selection range. Changing the range for PLUS to (235 to 312) increases its probability of selection to 0.078.

The learning section of the program changes the probabilities of selection of both operators and operands by changing the selection ranges. If the operator or operand was used in a successful algorithm, the selection range for it is increased. Since the sum of all selection ranges must equate to a fixed total (in our case, 1000) then the selection ranges for all other operands and operators must be reduced accordingly.

One important aspect of the use of these tables should be explained. Clearly, an algorithm which consists of one operator and two operands is too trivial to be interesting. For this reason, the tables themselves are capable of developing algorithms of much greater length and complexity.

An operation consisting of one operator and two operands, upon being executed, results in a single number. This number can be used as an operand in yet another operation. Thus, one of the entries in the operand table is: "create another operation." Any number of these operations can be nested giving algorithms of considerable richness.

If all ideas are the same as before, there is no creativity.

Let us use the symbol Z to indicate the operand "create another operation." Now, suppose the algorithm definition section selected the algorithm:

(PLUS x_{n-1} Z)

Upon seeing the Z, the program returns to the random number generator for three more random numbers, one for the selection of another operator and two for the selection of two more operands. Suppose this time the result was the operation:

(MINUS 3 n).

The total expression would now combine to form:

(PLUS x_{n-1} (MINUS 3 n)).

Assume the following values:

$x_{n-1} = 2$

$n = 4$

The expression would compute to:

(2 + (3 – 4)) = 1

If the probability of selection of Z is too high, every operation could require the creation of one or more additional operations, and the process would never reach resolution. I found that values for probability in the range from .1 to .25 were reasonable. The learning section of the program will modify these probabilities on the basis of successful trials.

Experience Using the Program

The program successfully solved all simple series given to it. It easily solved all of the series offered as examples in this article. It could solve any series that was constructable within the limits of the algorithm generator and consistent with relatively compact algorithms. As the algorithms needed for solution became more complex, the program had increasing difficulty.

One experiment revealed an unexpected truth about the creative process. I wanted to understand how the learning section would operate, so I offered the same series to solve repeatedly. On the first trial the program solved the series after about 500 fail cycles. With each succeeding trial the number of fail cycles declined. I continued to let the computer work on the problem for several hundred iterations.

Then, without thinking about the consequences, I asked the computer to solve another series, different from the first but of the same level of difficulty. This second series had been solved earlier with about the same number of initial fail cycles as the first. However, this time the program ran to a predetermined limit of fail cycles without finding a solution and "gave up." At first I thought there was something wrong with the program. Rather, a deeper insight was forthcoming.

Upon inspection I discovered that the tables had been updated by the learning section so many times that the machine was only generating the one algorithm that would solve the first problem. The definition section had lost all traces of randomness and was repeating the same mistake over and over. It had lost all creativity.

It is easy to think of solutions to the problem of over-learning in this program. It is more interesting to establish whether this phenomenon is peculiar to this program or the result of more general principles. My conclusion is the latter, as are other phenomena described or implied by the program. Hence, I believe it can be used to discuss and illustrate creativity by machines and other systems as well.

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Part 2

In Part 1, we posed the question whether computers can be creative. Using the series completion problem found in intelligence tests for an example, we described a computer program which solves those series by finding algorithms that can be used to create them. Using the same algorithms, it predicts the next entries in the series.

The program consisted of three sections. The first was an algorithm definition section which created possible algorithms using tables of operators and operands, and assembled algorithms from these tables using random numbers. The second was an algorithm evaluation section which tested those algorithms against the numbers in the series that was being evaluated. If the algorithm could successfully explain the fourth and fifth entries in a series of five numbers, the series was considered solved and the same algorithm was used to predict the sixth. The third section was *learning* in which the probabilities of selecting certain operators or operands were changed in favor of those which had been shown to be successful.

In this part of the article we will draw some parallels between the example problem and machine creativity in general.

If the algorithm could successfully explain the fourth and fifth entries in a series of five numbers, the series was considered solved and the same algorithm was used to predict the sizth.

To have an illustration for reference purposes, I have constructed Figure 2. The resemblance to Figure 1 is that here the three sections of the program are simply described as areas within a triangle divided into four parts.

The top part, Idea Definition, corresponds to the algorithm definition section of the program.

The middle right portion, Idea Evaluation, corresponds to the algorithm evaluation section of the program, and the Learning portion occupies the middle left.

A fourth area, defined as Environment, occupies the lower portion of the triangle.

Obviously, I use the term *idea* in a very general sense. It is a short way of saying "a proposed solution to a problem or need." An idea can take many forms: a piece of art, a computer program, a poem, or a model for a molecule.

Elements of The Creative Process

Let us describe the three basic elements of the creative process, using the example problem as a base.

What are the essential ingredients of the idea definition element of the process? First is the identification of a need for an idea. In a real-world situation this might be the discovery of a problem. It may be curiosity. In our example, the failure of a previously generated idea triggered the need for another one.

Another necessary ingredient is the availability of some raw materials from which ideas can be created. For this purpose, the idea generation section relies on the learning section to

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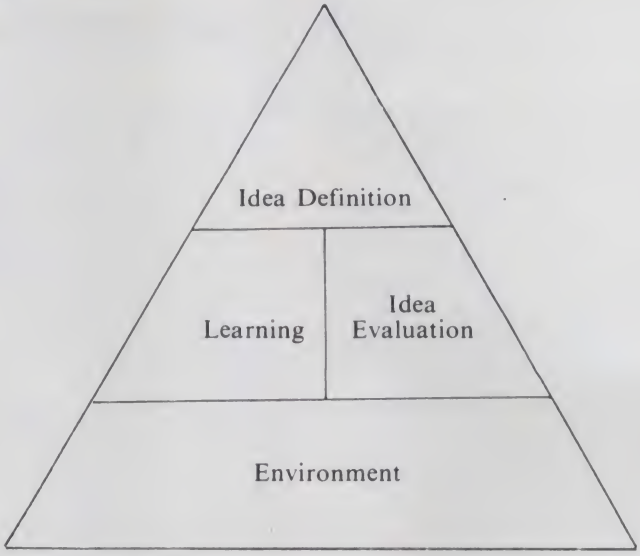

Figure 2. Generalized model of the creative process.

provide parts to be assembled. The example used tables of operators and operands that were maintained by the learning portion of the program. In life these may include related ideas that have been known to work before in other situations.

A third ingredient is the energy to perform the operations. Speed is a factor, and the more quickly an idea is generated the more can be generated in any period of time.

Rejecting a good idea increases the cost of idea definition, and accepting a poor one increases the cost of evaluation.

Finally, there is the important factor of newness. If all ideas are the same as before, there is no creativity. In the example, this was provided directly with random numbers.

If those are the ingredients of the idea definition process, what are the ingredients of a good idea? It must be relevant to the problem that is before us. There must be some chance that it will pass the evaluation.

This probability needs to be high if we are only able to generate and evaluate a few ideas within time and cost limits. They can be less likely to succeed if the generation-evaluation process is faster and less costly.

At first it may appear that newness and relevance are opposites. Not necessarily! An idea can have both characteristics. However, it is likely that ideas that have a high degree of newness are less likely to be relevant. Conversely, the most relevant idea is to do again what was done last time, which is not new at all.

Accuracy

The idea evaluation process also has measures that determine its value. The first of these is the inherent accuracy of the process. Psychologists have defined Type 1 and Type 2 errors. A Type 1 error is the acceptance of a bad idea, and a Type 2 error is the rejection of a good one.

Our example did not illustrate the accuracy problem, as we *defined* a correct answer as one that passed the two tests imposed by the evaluation section of the program. In a life situation, mistakes occur frequently, and the perfect evaluator is difficult or impossible to find. This section is created by developing a model of the environment in which the idea must survive, and no model of the environment is perfect. Those that are the most nearly so are the most useful for evaluation purposes.

Good examples of useful models are scientific laws. Any idea that violates the law of conservation of energy is probably not worth further consideration. Another useful law is the second law of thermodynamics which rules

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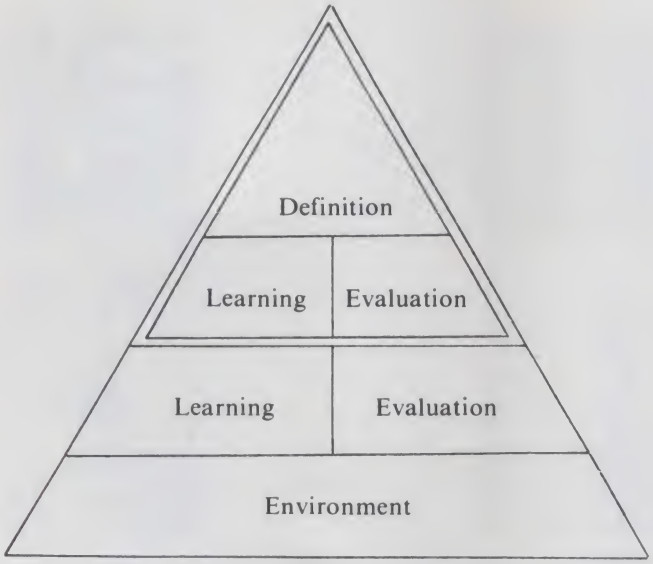

Figure 3. Generalized model of a nested creative process.

out all perpetual motion machines. The laws of science are so powerful that sometimes the idea derives from the law, being the only possible idea that is also consistent with the law. The elliptic trajectory of a satellite about the earth can be determined by finding that trajectory which is simultaneously consistent with conservation of energy, conservation of angular momentum, and the inverse square law of gravitation.

Speed and Cost

A second measure of the evaluation process is speed and cost. It is sometimes time consuming and expensive to evaluate an idea. Consider the company that introduces a new product only to see it fail in the market. Ford spent millions on one of the most publicized failures in American business, the Edsel. Yet, there are ways to reduce both time and cost.

Evaluation questions should be asked in an optimum sequence. The first questions should be the least expensive or time consuming and, upon application, have the highest probability of rejecting a poor idea.

But a cheap test which commits too many errors is costly in the long run. It depends on the situation whether Type 1 or Type 2 errors are the more costly. Rejecting a good idea increases the cost of idea definition, and accepting a poor one increases the cost of evaluation. Probably the best tests to have early are inexpensive and cull out the clearly poor ideas, but are more likely to accept a poor one than reject a good one.

A key responsibility of the evaluation section is to provide data to the learning section. Our example used only positive feedback; it updated the learning section only for successful trials. A more sophisticated evaluator might update with negative information. Had the example done so, it would have found a way out of the over-learning trap. A still more sophisticated one might inform learning which features of the idea are good and which are imperfect.

Many believe that the computer is able to aid creativity, but is unable to do the whole job.

The Environment

Upon completing evaluation, the idea passes to the environment, the final arbiter of the goodness or badness of the idea. The idea either lives or dies in the environment.

In the example, the environment was represented by the user of the program. The environment varies depending upon the nature of the idea. For the Edsel, the environment was the American auto buying public. For the artist, the environment is the set of people who decide when and where his works will be collected and displayed. For the scientist the environment is other scientists who test his theories against their own experiments. If people make up the environment, their actions count more than their opinions. The corny, irritating TV commercial may not appear to be creative, but if it sells toilet paper . . .

In some cases, the objective of an evaluation process is to establish whether the idea has sufficient merit to be passed on to another level of evaluation. The descriptive triangle in Figure 2 may be redrawn as in Figure 3, in which the three elements of one process (definition, evaluation, and learning) are viewed within the context of a larger process. The idea evaluation process in one stage simulates the idea evaluation process in the next, and so on for several stages in the process if necessary.

Information from the environment also passes to the learning section of the process. The learning section receives information from two sources, the evaluator which indicates whether the idea was perceived to have merit, and the environment which provides the actual result.

By accumulating this information, the learning section becomes a storehouse of possibilities as well as historical data on what works, what doesn't, and how it does it. Learning provides the data necessary for the development of models to be used by the evaluation section and the raw materials for the idea definition section of the program.

Breaking the creative process into three elements illustrates three distinctly different possible applications of computer power. The three elements are distinct in how the computer must be programmed, and we have seldom seen the computer applied to all three within the same problem. Yet, many examples show the use of the computer for one of the three. The remaining two require human intervention. As a result, many believe that the computer is able to *aid* creativity, but is unable to do the whole job.

Let us look at a few examples where the computer is used to support one of the three elements. In idea definition, the computer has been used to create words for the purpose of naming proprietary drugs and chemicals. The computer is programmed to print long lists of words using various rules of length and sound (such as ending with an "ex"). A human scans the lists to select those worthy of further consideration based on whether they convey the right feeling or leave the right impression.

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The computer has been used extensively for idea evaluation. As an engineer, I used the computer to design ballistic missiles. Selecting various parameters of size and weight, I would "fly" the missiles on the computer until I found the combination of factors that yielded a missile to go the distance which carried the maximum payload. The use of the computer in evaluation is extensive in engineering design as the laws of science are relatively simple to program.

As a storehouse of information, the computer has no equal if the information can be recorded by symbolic means. The computer is thus a strong contributor to the learning part of the process. Computers are used today to maintain libraries of information which can be retrieved in seconds. Applications are found in law, where the computer is used to find citations for legal questions.

It is apparent that the computer is theoretically capable of being programmed to accomplish all three parts of the process. One would expect it to be applied first where it is simplest to do so. So, where one of the three elements is capable of being programmed, we can expect it to be done, with the human required to cover the rest.

That which the human performs is likely to be the more complex part of the overall task. But for the computer to be called creative, it will have to be programmed to perform all three within a single problem. Problems in which all three elements can be programmed are likely to be relatively trivial for some time to come. However, part of this theory says that complex systems evolve over time, and such is likely to happen in this case as well.

A program that merely provides the logical consequence of a set of rules is not generating creative solutions.

Difficulties

So let us look at the three elements again to identify the difficulties which need to be overcome to achieve more broadly useful results.

One difficulty lies in idea definition where we ask the computer to create options that are both novel and useful. A program that merely provides the logical consequence of a set of rules is not generating creative solutions. In the series example, we used randomness to provide an element of newness in the algorithms which were generated. At the same time all algorithms were generated within very definite limits of what was possible using the operators and operands which were allowed and within the length of algorithms that were created. This assured some probability that the algorithms so generated had a chance, albeit a small one, of satisfying the criteria for a solution.

There is good reason to believe that enforced randomness is a useful tool in option creation. If we study the history of science we find numerous famous and creative discoveries which came about as a result of chance events. Quoting from Judson's *The Search for Solutions:*[1]

> "Pasteur or one of has assistants innoculated some chickens with a cholera culture from the wrong jar — it was old. The chickens got sick, but then recovered. Curiosity piqued, Pasteur innoculated the chickens again with a fresh culture known to be virulent. This time the chickens didn't even get sick."

Judson recounts several other stories where chance played a significant role, including the discovery of radium by Curie and of x-rays by Roentgen. And there are many others.

Randomness

Yet another example of randomness in the creative process is the sexual reproduction of complex living things. That two sexes are required, each providing some of the information needed to create a new life, demonstrates the principle of controlled randomness. An offspring is never an exact copy of either of the parents, yet it is sufficiently like them to have a high probability of survival in the environment.

Complex living things are constantly recreated. All parts of the living thing are changed slightly, with no intention necessary as to the merit of the changes. The interaction of the living thing with the environment determines whether the changes were for the better, represented by whether it participates successfully in the next reproduction cycle.

Non-sexual reproduction does not provide the mechanism for offspring to have variations and yield a high probability of survival at the same time. Differences which occur through mutation have a low probability of survival, and exact copies do not provide for the evolution of the species in the face of a changing environment. This explains why non-sexual reproduction is limited to simple organisms, where multiple billions of them are created giving the mutation method a chance to work.

But if some randomness is necessary for the creative process, too much can kill it. It is an old argument that a computer typing random letters will type all the works of Shakespeare if given enough time. Enough time com-

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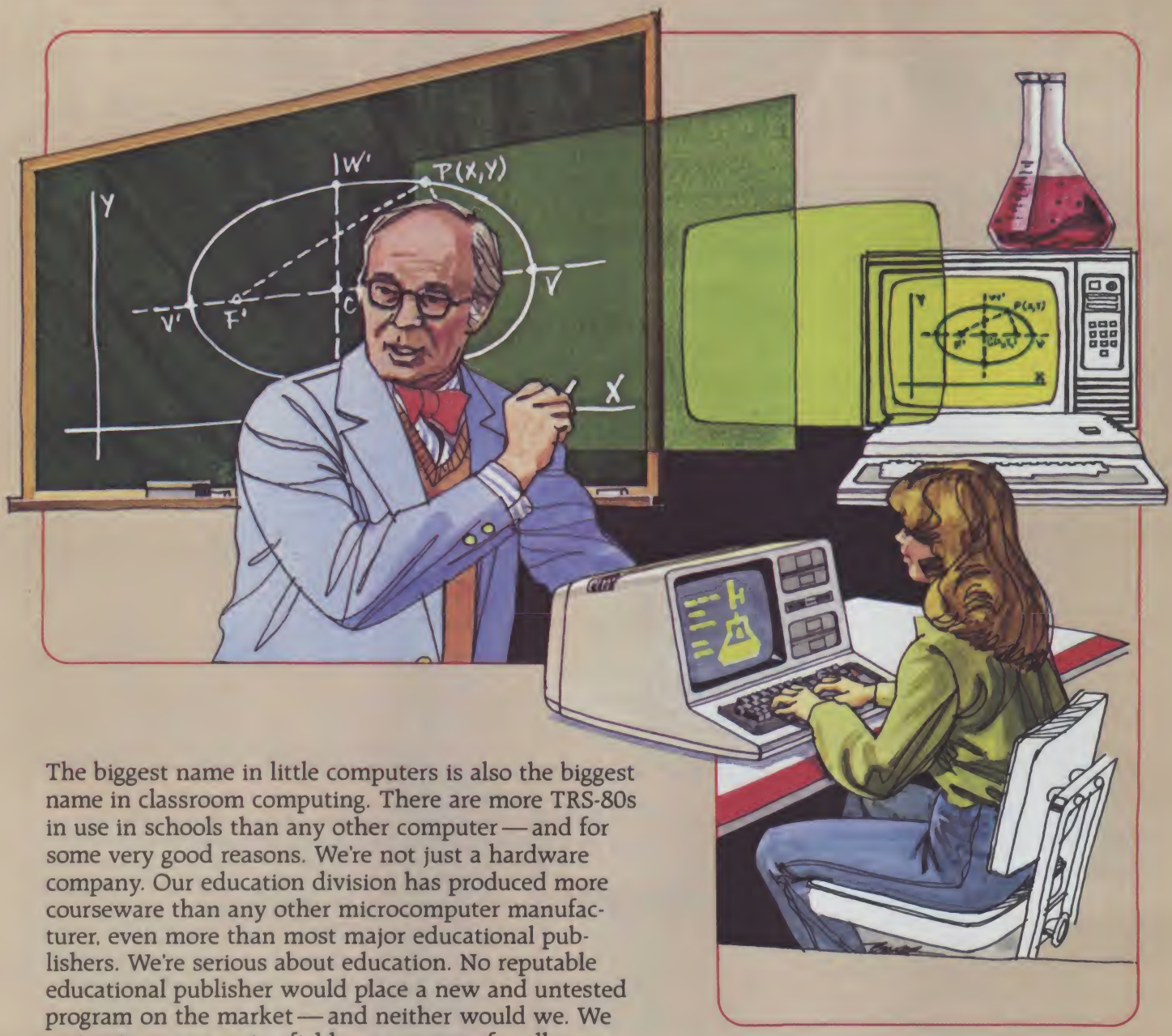

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putes to be longer than the universe has been around. This means that randomness can not be applied to create a complex result from scratch. The total project must be divided in some way, and randomness applied to each part with a suitable mechanism to evaluate and learn. It is then possible that something useful will evolve over time.

Measures of Performance

The evaluation section also offers considerable challenge. If evaluation can be based on well defined measures of performance, the task may be relatively easy. Such is true where one can apply the laws of science, or in game playing where the measure of performance is *win* or *lose*.

A large part of developing an effective evaluation section is the ability to specify what constitutes progress toward a goal. The advantage of having this measure is illustrated in Hans Berliner's Backgammon playing computer program.[2]

He employs a measure of performance for each move that permits the program to select those which improve the strategic position of the computer. His evaluation process does not wait until the game is over to determine measures of value, nor does it solve for all possible implications of each move.

A greater challenge lies where there are no programmable measures of performance. This occurs where the environment is too complex to permit a valid simulation of its behavior, for example, where the idea is a new product and sales are subject to whim and fashion. Evaluation is difficult where the values of performance are highly judgmental, as with art and music.

But it is here where the possibilities of computer learning are the most intriguing. It may be possible to analyze human judgments through trial and error, using large numbers of interactions with humans. The computer would offer ideas and the humans would indicate approval and disapproval. Computer learning would decipher the humans' rules of what is good and what isn't.

The learning section of the process is where the computer should excel. Consider the very use of the term "memory" for computer storage, a holdover from the '50s when computers were sometimes called "giant brains."

The problem with computer memory is not that it is limited; with technology improving indefinitely, the amount of storage available will boggle the mind. The real need will be to find the information that you want. But this problem is not insurmountable. Techniques for searching through billions of bytes of data using key search words or patterns exist. This includes the use of inverted files and relational databases.

The Future

This is not to minimize some real problems that will continue. The computer excels in storing symbols, but not pictures, three dimensional objects, or the human voice. Because of limitations, the storage of these items employs techniques which minimize the amount of storage required.

Much of the so-called education in creative thinking focuses only on removing inhibitions to the idea generation process, certainly a useful contribution but by no means the whole story.

But these techniques make the *use* of the data more complex. With the availability of large cheap storage, it will be possible to use techniques that do not interfere with the use of the information.

No one can predict the future with certainty, but I predict that the computer will eventually be used in areas that involve real creativity. Given difficult problems, it will surpass the ability of the human to perform the same creative task. The computer may give the appearance of "thinking" but whether it does is not important. What it will do is make use of the same principles that are employed by all creative systems, human and other.

This article has applied the principles of the creative process to the use of computers. Two other applications of these principles are equally interesting, but alas, are subjects of other articles.

One is *individual creativity*. We have made passing reference to this subject, but much more could be explored. For example, it appears that an individual passes through three stages as a creative person. The first is the naive stage, in which the idea definition process is active and uninhibited, but where the evaluation process is undeveloped. The third is the overlearned stage in which the evaluation process dominates, and learning has ceased to add new value.

The middle stage is the most creative, in which the three elements are in balance.

We need to discover means to enhance and lengthen the middle period. Much of the so-called education in creative thinking focuses only on removing inhibitions to the idea generation process, certainly a useful contribution but by no means the whole story.

The second subject is *organizational creativity*. Again, looking at the creative process, three distinct elements provide the key for analysis. We see the three working within the organization as separate entities, departments, or individuals. For example, the engineering department develops an idea for a new process and the treasurer says "no."

By understanding the process one can discover whether the various forces in the organization are strong and in balance, and whether the conflict that inevitably results is healthy or damaging. The organization learns through the collective experience of its members, and knowledge is maintained through its principles, policies, records, and procedures.

Organizations can easily become rigid, a parallel to the "overlearned" condition, and when faced with a changing environment, will eventually die. An organization that retains its creative flexibility, can adapt to the changing environment and survive. □

Footnotes

[1]Horace Freeland Judson, *The Search for Solutions*, Holt, Rinehart and Winston, New York, 1980, p. 71.

[2]Hans Berliner, "Computer Backgammon," *Scientific American*, vol. 242 n. 6, June 1980.

"Merry Christmas, terminals!"

Experience, Experiments and Intelligence

Don Berry

The on-going discussion of Artificial Intelligence (and hence Real Intelligence) has become so hopelessly mired in ambiguity and self-contradiction that I am beginning to dread the appearance of ever more writing on the subject.

By now it is clear that what emerges from this game is more intricate software and more elaborate circuitry. If this is our goal, then we can (and should) dispense with the metaphysical mumbo-jumbo that accompanies it. No one doubts that we can continue to create more complex devices to handle data in more complex combinations. That's what we (the Aristotelian cultures) are good at.

But it must be obvious to any reasoning person that it is a hopeless and foolish task to apply rigorous logical thinking to a series of word-elements that have no definite meaning in our language. Words such as "thought," "consciousness," and "awareness," are vague, connotative generalities in English. This is partly because of the fundamental nature of English, and partly because the amount of energy we have devoted to investigating such ideas is negligible, at least in comparison with other cultures.

It has been our cultural bent in the past few thousand years to devote our attention almost exclusively to manipulation of physical elements. Our knowledge of "mind," "consciousness," and so forth, is at the witch doctor level, and everyone knows it.

Our mechanical proclivities lead to an unfounded (and virtually unquestioned) assumption, best stated by our current Aristotelian spokesman Carl Sagan. In his own study of consciousness he sets forth (as axiomatic) that consciousness is a by-product of brain activity.

Well, OK. Unfortunately, there does not exist a single shred of experimental evidence to support that assumption. It is merely the naive expression of a cultural bias in favor of mechanical explanations.

It is a somewhat infantile hope—and also contrary to the spirit of scientific investigation—to believe that if we can just get things complicated enough we will arrive at some simple insight into the nature of intelligence. It reeks of the superstitious mentality which will not consider any alternative that contradicts its own tightly held assumptions.

It seems to me that the roots of this hairy confusion about intelligence lie in these elements:

1. The cultural assumption that intelligence is the by-product of physico-chemical activity in the brain.
2. The unusable vagueness of the "living" languages in describing interior functions.
3. Lack of true experimental investigation of the nature of consciousness. AI is the futile attempt to duplicate something without any real knowledge of what the "something" is.

It is the primary faith of Western science, and the foundation of the experimental method, that experience is to be preferred over theory. "Experiment" originally meant "experience," and still does in many Latin-based languages.

However, all experience, by its nature, consists of the interaction between two elements, the experiencer and the thing experienced. This interaction is the only thing which gives meaning to the notion of experience. We have chosen to exclude the experiencer part of the equation, in the hope of reducing "subjective" error, personality factors, etc.

This exclusion has indeed been very useful, but its utility has limits. One cannot arbitrarily exclude 50% of an event and hope to arrive at an intelligent assessment of that event.

One would have thought that the discoveries of quantum mechanics and their experimental verifiability would have demonstrated the limits of this so-called "objectivity." The Schrodinger wave equations demonstrate without ambiguity the necessary interaction between the observer and the observed.

It is the clear statement of the Schrodinger equations, and, indeed, quantum theory in general, that this phenomenon we call "world" comes into being through the interaction of the "subjective" and "objective," and not in any other way.

This would, of course, come as no surprise to the Buddhists, Vedantins, and Yogis, who have been saying the same thing in very precise terms for a couple of thousand years.

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Guest Editorial, continued...

It is not generally understood in the West that these observations by Eastern thinkers are based on experimental evidence. That is to say, their results are duplicatable by following the same experiential procedures. Since this is the criterion we use to validate our own experimental results, it is a little obscure why we choose to ignore it in evaluating theirs. It has been our amusing habit to assume that we can make accurate evaluations on the basis of our convictions, rather than by duplicating their experiments.

The Indian experimenters, however, have had at least one tremendous advantage over the West. That is the use of a mathematically precise language to describe their area of investigation.

The Sanskrit language has not "evolved" in the same sense that languages such as English have. It is, rather, a "constructed" language, which has been designed to express accurately the nature of conscious experience. In this it more closely resembles mathematical symbolism than English.

Unquestionably the greatest impediment to useful scientific investigation in any culture is the rigidity of that culture's conditioning.

There are in Sanskrit, for example, about 30 words describing precise levels of conscious function, all of which would (feebly) translate into English as "mind." It reminds one of the Eskimo vocabulary describing the many varieties of snow which we scarcely even perceive because we don't care that much about it.

I am not suggesting by this that we should trade in our three-piece suits for *dhotis* and go live in *ashrams* until we get it straight.

I am suggesting, however, that the overweening arrogance created by our mechanical accomplishments has blinded us to the fact that we are not the only intelligent human beings on this planet, and that others may well have systematically explored areas which baffle us and our methods, just as we have explored areas which baffle them.

Unquestionably the greatest impediment to useful scientific investigation in any culture is the rigidity of that culture's conditioning. We need to step a little outside our own conditioning to discover anything at all, much less something as fundamental as the nature of consciousness.

Since we already "know," with Carl Sagan, that consciousness is a by-product of brain activity, we are prohibited from examining the alternative. It is the unanimous conclusion of Indian experimenters that such is not the case. It is their conclusion that the brain is a marvelously complex and subtle mechanism for handling sensory and mental data, but is not, in itself, the source of conscious awareness.

In short, it is the opinion of those who have most thoroughly investigated the issue that the "subject" side of experience (that is, consciousness, awareness) is complementary to, but not derivable from, the "object" side (that is, physical phenomena).

Perhaps it would be worth looking into the researches of those who have traditionally investigated interior states for some insight into our own confusions. □

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From Burn-Out To Born-Again

Witold K. Urbanowicz

'Twas the week before Christmas and all through the house...You get the picture. I had just come in from walking the dog. It was late and, more important, the house was quiet. The rest of the family was tucked away for the night. So was the Atari 800.

There it sat neatly stacked on the living room shelf. Next to the cassette player lay operating manuals along with little boxes labelled *Bio-Rhythms* and *Star Raiders*.

Vacationing friends had kindly consented—after a few subtle hints from my nine-year old son—to leave their personal computer in our care. So for the past week, our living room had been an extraterrestrial battle-zone. The walls echoed with the sounds of hyper-space thrusters, photon-lasers and thermonuclear explosions. My wife and I kept our distance. She could not stand the noise and the violence. For me, there were other reasons.

I had spent the better part of my early adult life programming, analyzing, and trouble-shooting commercial computer systems. As I looked at the compact console sitting there on the shelf, my mind went back about ten years.

I could still remember being ushered through a door into a room about the size of a basketball court. It was like walking into the future. Inside this air conditioned, climate controlled world sat the company's four computer systems, along with their respective disk drives, tape drives, printers, and various other peripherals.

I was led past rows of lights flashing on main frame panels. Long lines of tape drives danced back and forth. Disk packs whirled secretively inside their stacked enclosures. Printers spewed out reports by the truckload. Adrenalin began racing through my own system at a speed, I was certain, approaching that of the computers themselves.

Each of the four computer systems had a nickname. "Poppa Bear I" and "Poppa Bear II" were twin systems with individual core capacities in the megabyte range. These were used to run the major financial systems of the corporation. "Momma Bear", weighing in at 512K, was devoted to teleprocessing. It communicated with computers across the country. "Baby Bear", a little 48K three-partition machine was used nights for the smaller systems, but during the day was dedicated to the programming and systems people for compilations and testing. "Baby Bear" was to be my own personal computer for the next few years.

As the years passed, the software became more complex, requiring more and more core as well as faster and faster processing speeds. My skills and responsibilities were naturally upgraded to keep up with the larger and more complex applications. As deadlines became more critical and the problems more intricate, the pace became absolutely frantic. Murphy's Law reigned supreme.

"Baby Bear" became a dim memory and my family life was in danger of becoming the same. By now it had become a frequent occurrence for me to work months on end at all hours in order to bring a project in on time. For the most part, the results of this effort—the *bottom line*— were meant for someone I would never meet in a city I would never see.

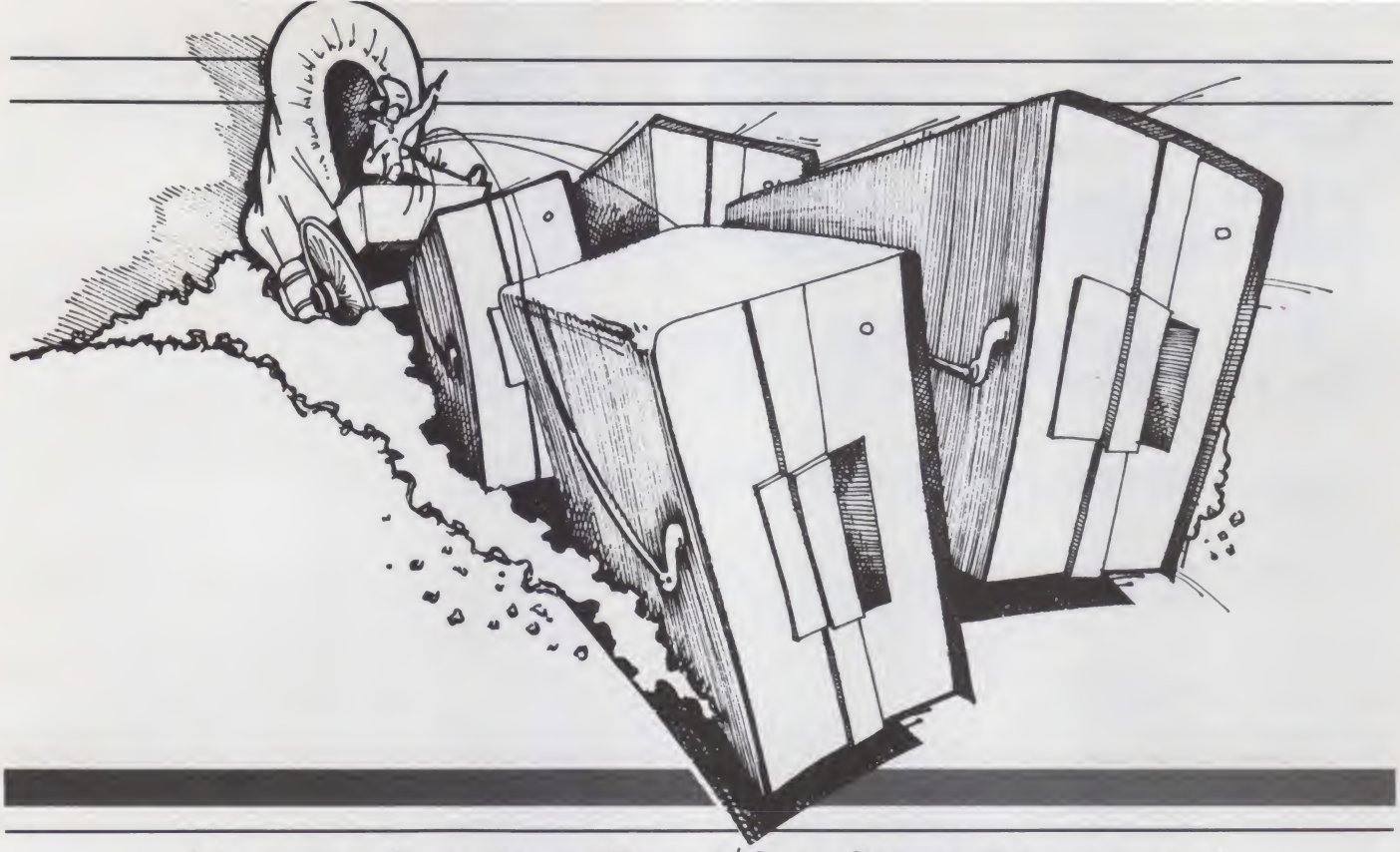
Several times after the project had been completed, I asked whether it was serving the intended users well, only to discover that the project had been scrapped or that the reports were piling up somewhere in a storeroom in unopened boxes.

About the third or fourth time this happened, I was sitting in the computer room at five in the morning. I had gone about 72 hours without sleep. It had been months since I had seen the kids. I felt as gray and flat as the tile floor beneath my feet. It was then that I decided to leave the field.

When I left, I never wanted to see another computer in my life. Any thrill or satisfaction I may have felt in the early part of my career had not just disappeared. It had been slowly ground out of me.

All these thoughts and images ran through my mind in a matter of nanoseconds that evening as I stared at the Atari on the shelf. It seemed to be waiting for me. I wondered if I had put enough distance between myself and

Witold K. Urbanowicz, 135 Eastern Parkway, Brooklyn, NY 11238.



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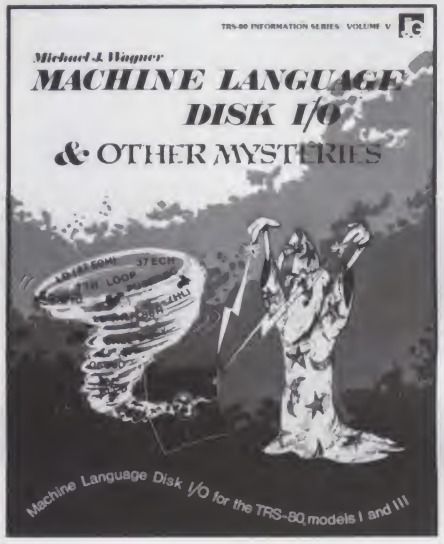

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the past. After all I had been out of the business for several years. How could it hurt to sit down for a few minutes to see what the little fellow could do?

In less time than you can say Beginners All Purpose Symbolic Instruction Code, I had the Atari off the shelf and ready to go. Although I had never programmed in Basic before, there was enough of a logical similarity to other high level languages that with a little prompting from the Basic manual I was off and running.

Over the next few evenings, I reintroduced myself to the world of IFs, THENs, GOTOs, strings, subscripts and various other programming concepts. The feeling was definitely odd. It was like meeting old friends I had not seen in years. They had not changed one bit—for better or for worse. Some, like the nested IFs, still caused me no small amount of trouble whenever I took them for granted. Others, as in the case of the GOTO, were still as straightforward as ever.

Then suddenly, about two nights before Christmas as I worked my way through Sound and Graphics, it hit me. Without even realizing it, I was having fun. It was like the old days when I had worked with "Baby Bear" at my first job. But there was a significant difference. The room I sat in was my own. The light by which I worked was soft. The colors and fabrics in the room were part of a human environment. I did not have to fight anyone to get computer time. I was a person enjoying a personal experience.

Now it was time to put together what I had learned the past few evenings. What better way was there than to write a program. The question was, what to write? The answer came quickly. With Christmas not two days away, what better project could there be than to create a present for the children—a small electronic game they could play.

After a bit of thought, I set down some basic specifications. The program would have to be relatively straightforward and short. I didn't have that much time. Plus I was still quite rusty. However, I wanted something that would pose an appropriate challenge to my skills. Finally it also had to be something the children would find entertaining as well as challenging.

I finally decided on an electronic version of the old Shell Game. Working into the early hours of the morning, I was able to finish the initial logic for the game, leaving the testing for the following night.

And so the proverbial Night Before Christmas found St. Nick at his Atari testing a last minute present for the big day. Time flew, and soon the morning light seeped into the living room to announce the arrival of the children as they made their way to the tree and the presents which lay beneath. They were somewhat surprised to find me up at that hour.

"What are you doing?" they asked.

"You'll see," I managed to reply.

Paper ripped and the camera clicked. In less than an hour the booty lay displayed. My daughter modeled her clothes while my son booped and beeped his way to electronic heaven with his new hand-held game.

Several hours later, my daughter remembered seeing me when she had first awakened. Leading the kids to the living room, I told them to turn on the computer. This they did and sat down to play. I watched as their faces lit up while trying to follow the shells being moved around on the screen. I followed the squeals of delight when they guessed which shell the pea was under and groaned along with them when their guesses were wrong. Finally my daughter turned to me.

"Daddy, you did this?" she asked.

I nodded.

"Really?" my son added.

All I could do was beam.

Seeing the "bottom line" in my children's faces, I forgot about the hours of frustration the night before while debugging the program. The thrill and satisfaction I had felt years ago when I first worked with "Baby Bear" had returned. Unfortunately, so did the neighbors.

I was actually sad to see the Atari go. Still, I had been given a second chance to look into the future and found once more that it was good. □

Listing 1.

```
5 DIM A$(1)
7 DIM B$(1)
10 MOVE=100:MVA=1:MV2=2:MV3=3:MV4=4
20 MV5=5:PH=0:P1=1:P2=1:P3=4
30 X10=10:X15=15:X20=20:POS1=1
40 NEG1=-1:NXTMOV=600:RNDMOV=800
45 SETUP=900
50 FRTY=40:FIFTY=50
60 Y=10:Z=Y:SV2=2
80 X40=40:X60=60:X80=80
85 ZERO=0:MV10=10
90 GRAPHICS 3
92 COLOR 2
94 SETCOLOR 4,9,2
96 GOTO 300
100 FOR M=MVA TO MVB
110 COLOR 2
120 PLOT X,Y
130 PLOT W,Z
140 FOR S=SVA TO SVB:NEXT S
150 COLOR 4
160 PLOT X,Y
170 PLOT W,Z
180 X=X+XV:Y=Y+YV
190 W=W+WV:Z=Z+ZV
200 NEXT M
205 COLOR 2
210 PLOT X,Y
220 PLOT W,Z
230 RETURN
300 REM * * * MAINLINE * * *
400 GRAPHICS 7
405 COLOR 1
410 SETCOLOR 4,9,2
415 PLOT 61,39:DRAWTO 62,39
420 PLOT 61,38:DRAWTO 62,38
425 Y=32
427 RNDH=ZERO
430 FOR M=MVA TO MV4
435 COLOR 2
440 PLOT X40,Y:DRAWTO X40+3,Y
445 PLOT X60,Y:DRAWTO X60+3,Y
450 PLOT X80,Y:DRAWTO X80+3,Y
455 Y=Y+1
460 NEXT M
465 PRINT "READY?"
470 INPUT A$
475 IF A$<>"Y" THEN 465
480 P1=4:P2=1:P3=4
485 FOR M=MVA TO MV4
490 COLOR 2
500 PLOT X40,Y:DRAWTO X40+3,Y
505 PLOT X60,Y:DRAWTO X60+3,Y
510 PLOT X80,Y:DRAWTO X80+3,Y
515 FOR S=SVA TO FIFTY:NEXT S
520 COLOR 4
525 PLOT X40,Y-4:DRAWTO X40+3,Y-4
530 PLOT X60,Y-4:DRAWTO X60+3,Y-4
```

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Burn-Out, continued...

```
535 PLOT X80,Y-4:DRAWTO X80+3,Y-4
540 Y=Y+POS1
545 NEXT M
560 GRAPHICS 3
570 COLOR 2
575 SETCOLOR 4,9,2
580 Y=X10:Z=Y
585 PLOT X10,Y
590 PLOT X15,Y
592 PLOT X20,Y
595 NXTCNT=X15
600 NXTCNT=NXTCNT-POS1
605 SVB=SVB-CH
610 IF NXTCNT=ZERO THEN 650
620 RNDMOV=((INT(3*RND(1)))*10)+800
622 IF RNDH=RNDMOV THEN 620
624 RNDH=RNDMOV
630 GOTO RNDMOV
650 GRAPHICS 7
652 COLOR 2
654 SETCOLOR 4,9,2
656 Y=X20+X20:XA=Y:XB=Y+X20:XC=Y+Y
660 WA=XA+3:WB=XB+3:WC=XC+3
670 FOR M=MVA TO MV4
672 COLOR 2
674 PLOT XA,Y:DRAWTO WA,Y
676 PLOT XB,Y:DRAWTO WB,Y
678 PLOT XC,Y:DRAWTO WC,Y
679 Y=Y-POS1
680 NEXT M
685 PRINT "PICK A SHELL - A,B,C"
687 INPUT A$
690 Y=36:Z=Y
692 IF A$="A" THEN 700
694 IF A$="B" THEN 710
696 IF A$="C" THEN 720
698 GOTO 685
700 C=P1:X=X40:W=X+3
705 GOTO 725
710 C=P2:X=X60:W=X+3
715 GOTO 725
720 C=P3:X=X80:W=X+3
725 FOR M=MVA TO MV2
730 COLOR 2
732 PLOT X,Y:DRAWTO W,Z
734 FOR S=SVA TO FRTY:NEXT S
736 COLOR 4
738 PLOT X,Y+4:DRAWTO W,Z+4
740 COLOR C
744 PLOT X+1,Y+4:DRAWTO X+2,Z+4
746 Y=Y-POS1:Z=Y
748 NEXT M
750 FOR M=MVA TO MV2
752 COLOR 2
754 PLOT X,Y:DRAWTO W,Z
756 FOR S=SVA TO FRTY:NEXT S
757 COLOR 4
758 PLOT X,Y+4:DRAWTO W,Z+4
760 Y=Y-POS1:Z=Y
762 NEXT M
775 IF C=POS1 THEN 790
780 PRINT "PICK ANOTHER"
785 GOTO 687
790 PRINT "GOOD EYES !"
792 PRINT "READY FOR A CHALLENGE ?"
793 PRINT "ENTER 1 OR 5 OR 10 OR 20"
794 INPUT CH:CH=MV2*CH
795 GOTO 300
800 X=X10:W=X20:MV=MV10
803 PH=P1:P1=P3:P3=PH
805 GOTO SETUP
810 X=X10:W=X15:MV=MV5
813 PH=P1:P1=P2:P2=PH
815 GOTO SETUP
820 X=X15:W=X20:MV=MV5
823 PH=P2:P2=P3:P3=PH
825 GOTO SETUP
900 XV=ZERO:YV=POS1
905 WV=ZERO:ZV=NEG1
910 MVB=MV3
915 GOSUB MOVE
920 XV=POS1:YV=ZERO
925 WV=NEG1:ZV=ZERO
930 MVB=MV
935 GOSUB MOVE
940 XV=ZERO:YV=NEG1
945 WV=ZERO:ZV=POS1
950 MVB=MV3
955 GOSUB MOVE
960 GOTO NXTMOV
```

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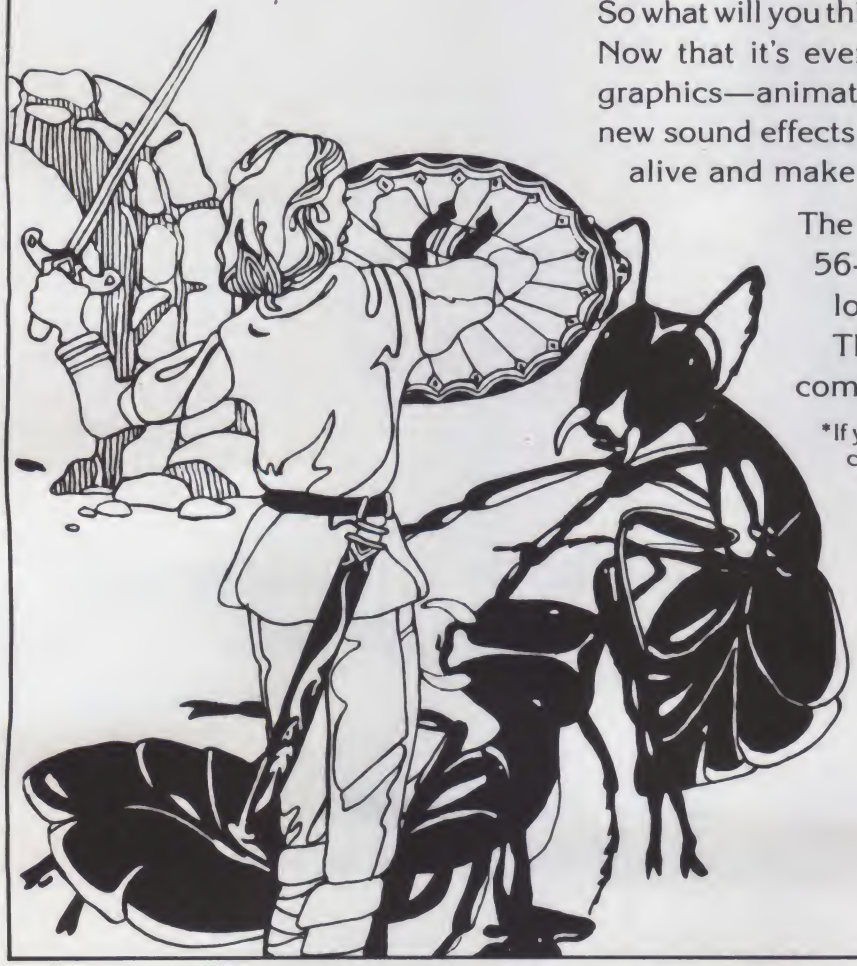

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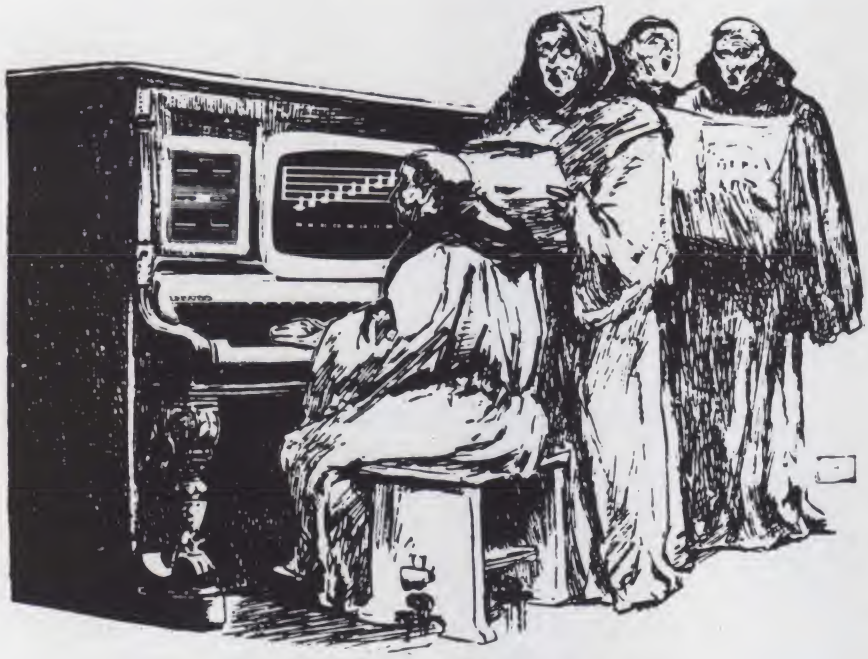

Rupert the Red-Rimmed Hacker

Rupert the red-rimmed hacker
Had a shining subroutine
Just couldn't get it working
Without locking his machine.

Olive, Rupert's main backer
Laughed and said "Forget it, hon"
She didn't think poor Rupert
Could ever make the damned thing run.

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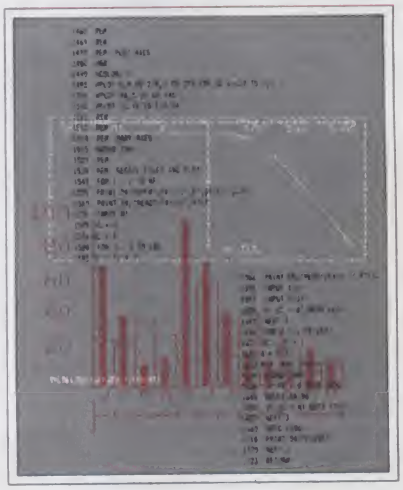

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Logo Ideas

Robert Lawler

Computers And People

Is playing with computers good for children? Couldn't it be bad? Might they not begin to think of themselves and others as machines? Here is a story about how my daughter, Miriam, pretended to be a machine — the Logo turtle — and what she made of that.

This night is the last night of summer, so defined by the children's having to begin school on the morrow. Over the summer they have gradually become accustomed to going to bed late, and now, in order to rise early, they should go to bed early. No one found this argument convincing. We negotiated a compromise that the children get into pyjamas, return for dessert (delayed by conversation with dinner guests, Jose and Fernando), and then go off to bed. Robby lived up to the agreement; Miriam would not.

When given a direct order to go to bed, she went to my bed instead of hers. I had mentioned during dinner the children's inclination to play turtle. Fernando tried to help. "Miriam, FORWARD." She did nothing. I advised him that he had omitted the carriage return. Upon his "carriage return" Miriam complained, "You haven't told me how far to go," chuckled, and popped back onto my bed. Gretchen attempted "FORWARD 100, carriage return." With the gripe "You haven't told me how to FD100" still in the air, I described this bug as the well known space omission between command and input.

Fernando was then precise: "Miriam: FORWARD, space, 100, carriage return." Miriam played fair and proceeded stepwise (counting each step) down the length of the loft. At first, we expected 100 steps to be too few. Miriam counted 70 in the kitchen and at 88 gleefully announced "Out of bounds" as she walked into the wall in the hallway. While so close to her bed room, she picked up her "security blanket" (the air was a little chilly) and came skipping back into the living area.

The game wore on (hide turtle under the blanket, and so forth), and after a while became wearing. I finally directed her to bed with the threat of physical force. Miriam replied, as she has for some months now, with the counter-threat "I'm quitting your research, Daddy, I really am." Having thus preserved her dignity, she acquiesced to the demand that she go to bed.

In this incident and many others, Miriam showed that this robot role which she was willing to adopt was one she subjected utterly to her ends as a person. Playing turtle was an enrichment of her repertoire, not a constraint upon it. As we paraphrase William Blake:

Tools were made; born were hands.
Every child understands.

Robert Lawler, Centre Mondial, Informatique Et Resources Humaines, 22 Avenue Matignon, 7508 Paris, France.

Single-Key Interfaces

Young children, especially those who have never used a typewriter — and even more so those who have not yet learned to read — can have a great deal of fun with turtle geometry if using the keyboard is made simple for them. One obvious and simple way to do so would be to make an "interface" for their use. An interface translates what someone keys into Logo commands and then executes those commands. Many have been made in the past, and surely more will come. Typically, the simplifications are in reduction of the child's keying burden to a single character for any action desired. For example, when the child keys the single character F, the interface translates this into the command FORWARD 20 and executes it.

Many computer-based games depend upon the speed of reaction of the person playing the game. Consider a real-time game in which you must fire a rocket to change the trajectory of a space ship. Keying FIRE and "return" could take so long that the result of the force would be different from what you wanted. In contrast, keying a single letter whose value was encoded to mean FIRE could be effective at once in changing the speed of the space ship.

Have you ever wondered why the letters on the typewriter keyboard or the computer terminal are where they are? Alvin Toffler relates the history of keyboard development, pointing out that the keyboard arrangement was made difficult on purpose, to slow people down so that their high speed keying would not jam the originally slow-moving mechanical linkages of early machines. Would you like to make your own keyboard arrangement? You can. All you need is an interface which will substitute your characters for those wired at the keyboard, and a set of sticky labels to show how the interface will assign meaning to the keys struck.

Summary

Writing an interface which reads one character at a time is a primary way of shaping your computer environment to be what *you* want it to be like. You can make it simpler, or more responsive; you can even change the meanings of individual keys. □

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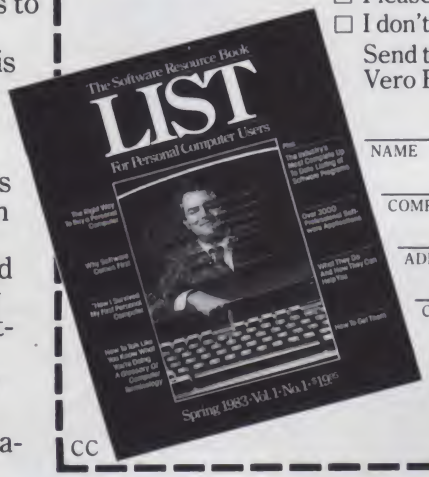

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The Countess And The Computer Language

Part II

Geoff Gilpin

Ah, you've returned. The Countess of Lovelace is pleased that you are interested in learning more about her namesake, the computer language Ada. Before plunging into new material, however, here is a recap of what happened last month.

After a brief history of Ada (both the Countess and the computer language), we saw a genuine Ada program, like this one:

```
with TEXT_IO; use TEXT_IO;
procedure EXAMPLE is -- specification

begin -- body
put ("Lady Lovelace welcomes you back!");
end EXAMPLE;
```

As illustrated by EXAMPLE, Ada syntax is very much like that of Pascal or any number of high level "structured" languages. The most prominent difference so far is the division of EXAMPLE into a *specification*, which gives the information needed to connect the program with its environment, and the *body*, which details the actions taken when the program is run. The specification of EXAMPLE tells the Ada compiler that a *package* called TEXT_ IO is part of the environment of EXAMPLE. The *put* procedure used to print the Countess's greeting is contained in TEXT_ IO and would be unavailable without the *with* and *use* clauses.

Aside from general syntax, last month's article looked at how data is defined and manipulated in Ada. We saw that all the usual data types and structures are available as well as several exotic ones. We saw user defined types:

```
type SECONDS is integer range 1..60;
```

derived types:

```
type MY_INTEGER is new integer;
```

enumeration types:

```
type COLOR is (RED, BLUE, YELLOW);
type BEATLE is (John, Paul,
                George, Ringo);
```

and many other strange and wonderful things.

Although Ada is the first language to incorporate all of the features discussed last month, nothing that we saw could be considered truly unique. Now, however, it is time to look at the most important, and most revolutionary, feature of Ada—program organization.

In Ada, the concept of a "program" is very nebulous. An Ada program is rarely a single entity; instead it is a confederation of smaller units woven into a loose hierarchy. Although things get blurry here, the Department of Defense suggests that Ada program units should be grouped together into a *library*, a vague term that says little about the overall structure of the language. Things will undoubtedly get clearer as the language evolves.

Ada programs can be constructed from a variety of building blocks. These *program units* can be combined in several ways to accommodate different styles of programming. Since the permutations can become very confusing (Ada is a *big* language), I will restrain myself and pull just two program units (subprograms and packages) out of Ada's grab-bag, using each to illustrate a particular style of programming.

An Ada subprogram can be a *procedure* or a *function*. Here is an ordinary looking example:

```
function SUM (X, Y, Z: integer)
         return integer is

begin
return X+Y+Z;
end SUM;
```

Geoff Gilpin, 1018 N. Leminwah St., Appleton, WI 54911.

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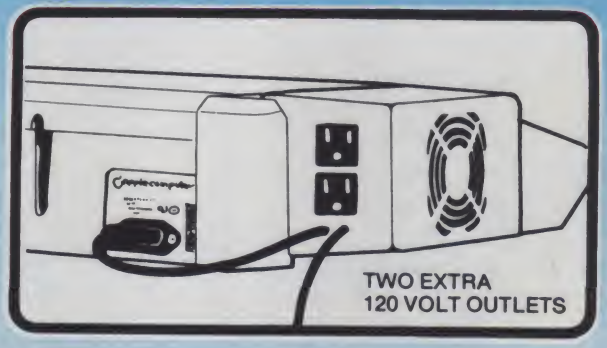

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Parameters

This example demonstrates the basic syntax of an Ada function. The *formal parameters* X, Y, and Z are listed along with their mandatory data type. The type of data returned by the function appears in the specification after the keyword *return*. Formal parameters can be of different data types, in which case they must be separated by a semicolon, as in

```
procedure HARMONY (HIGH,
                   MIDDLE,
                   LOW:      BEATLE;
                   SINGERS: INTEGER) is
```

Once declared, subprograms are invoked in the normal way, e.g.

```
A := SUM (B, C, D);
```

or

```
HARMONY (John, Paul, George, 3);
```

As usual, function calls may be part of a larger expression while procedure calls must appear on a line by themselves.

Aside from a data type, formal parameters may also have a *mode* that determines how they are matched up with the actual parameters in the calling routine. Modes come in three flavors: *in out*, and *in out*. Here is a procedure that illustrates modes:

```
procedure SQUARESUM (X: in integer;
                     Y: in out integer;
                     Z: out integer) is

begin
X := X**2;    -- "**" is
Y := Y**2;    -- exponentiation operator
Z := X+Y;
end SQUARESUM;     -- no "return"
```

Our new example procedure might be invoked like this:

```
X_TERM := 3; Y_TERM := 4;
SQUARESUM (X_TERM, Y_TERM, ANSWER);
put (X_TERM);   -- Pardon all the
put ("   ");    -- "put" statements.
put (Y_TERM);   -- Ada needs one
put ("   ");    -- for each
put (ANSWER);   -- data type.
```

and the resulting output would be:

```
3   16   25
```

X TERM was unchanged because its corresponding formal parameter was declared with the *in* mode, which is used for accepting a value without modifying it in the calling routine. Following this example, you will probably see that *in out* formal parameters *do* modify the variable in the calling routine, in this case leaving Y TERM equal to the square of four. The last mode, *out*, is only used for passing values back to the calling routine.

In other words, *in* parameters can enter a subprogram but not leave it, *out* parameters can leave but can't get in, and *in out* parameters can do both. If no mode is specified, *in* is assumed.

Now things start to get interesting.

When a subprogram is called, the formal parameters may be explicitly named. The function call

```
A := SUM (Y => 5, X => 6, Z => 10);
```

would assign a value of 21 to A. Notice that when the formal parameters are named, they may appear in any order, just like the array aggregates we met last month.

Subprograms may have *default* parameters, which are declared by an assignment within the parameter list.

```
function SUM (X: integer := 1;
              Y: integer := 2;
              Z: integer := 3)
                 return integer is
```

SUM may now be called with anywhere from zero to three parameters, the ones left unspecified will take the default values. All the following are legal calls.

```
A := SUM;              -- A=6
A := SUM (4);          -- A=9
A := SUM (4, 5);       -- A=12
A := SUM (4, 5, 6);    -- A=15
A := SUM (Z => 10);    -- A=23
```

Overloading

One of the most powerful features of Ada subprograms is called *overloading*. This means that multiple procedures or functions can be declared with the same name. For instance, a single Ada program might contain these two functions:

```
function SUM (X, Y, Z: integer)
             return integer is

function SUM (X, Y, Z: float)
             return float is
```

A Pascal compiler attempting to make sense of this program would halt at the second function and complain "identifier declared twice." In Ada, everything is fine. Once compiled, an appropriate test for the overloaded function SUM might be

```
put (SUM (4, 5, 6)); put ("   ");
put (SUM (4.0, 5.0, 6.0));
```

which will produce

```
15    15.0
```

Does this seem strange? It shouldn't—the concept of overloading has been around for a long time, and you have probably made considerable use of it without knowing it. Most common languages have a set of built-in routines, such as math functions, which are overloaded.

In Fortran the function SQRT can be used to take the square roots of both integers and real numbers. The same routine is not used in both cases, of course, since the internal operations used on one kind of number would not work on the other. When you put SQRT(4) and SQRT(4.0) in the same program, Fortran looks at the parameter and calls the appropriate routine. There is no need to write a SQRE routine for reals and a SQIN for integers since the data type of the argument makes it clear which you want.

Up till now, however, overloading had been present only in built-in functions; Ada makes it available to the programmer.

This review of subprograms will end with a look at an especially bizarre kind of overloading (which is also one of my favorite things in Ada).

Consider the statement HUE := RED. How is this different from the statement NUMBER := 2? Assigning a number to a variable involves a different set of operations than the assignment of an enumeration value, yet both are represented

by the operator :=. That's right, operators are overloaded too and, yes, the programmer may do the overloading.

All standard Ada operators—+, /, mod, **, etc.—are available for redefinition. A computer dating service might use operator overloading to do complex processing of data structures called MALE and FEMALE. The process would look just like the previous example of overloading except that the function name (since operators are used in expressions their overloading must always be done in function subprograms) is the operator symbol.

```
function "+" (MAN:   MALE;
              WOMAN: FEMALE)
              return COUPLE is

begin
WEDDED_COUPLE.HUSBAND := MAN.NAME;
WEDDED_COUPLE.WIFE    := WOMAN.NAME;
return WEDDED_COUPLE;
end "+";
```

A wedding may now be accomplished by the statement

```
NEWLYWEDS := BRIDE + GROOM;
```

where the variables WEDDED COUPLE and NEWLYWEDS are of type COUPLE and BRIDE and GROOM are variables of the FEMALE and MALE types. The expression BRIDE + GROOM produces a value of type COUPLE which can be legally assigned to NEWLYWEDS. In this case, the + operator certainly doesn't stand for numeric addition; perhaps it could be referred to as the "mating" operator.

Without overloading, the only operators normally available for use with user-defined data types are assignment (:=) and equality (=) although the other relational operators are defined for enumeration values. If you want to add complex numbers (as in Fortran or PL/1) you must first define them and then overload the appropriate operators. If you want matrix arithmetic (as in Basic) the process is repeated. This might seem odd for a language with so many built-in features, but the added power and flexibility are certainly worth it. This is one area of Ada in which the programmer's imagination is given free rein.

As I said, different program units illustrate different styles of programming. Ada supports two styles—*top down* programming, implemented with procedures and functions, and *bottom-up* programming which is done with packages.

"Ten to one we get cancer from these things, Squeaky."

Top-Down Programming

The top-down method is the classic structured programming strategy in which a big program is divided up into small, easily implemented pieces. In Ada, procedures and functions may be nested within themselves (and within other program units) to an arbitrary depth. They may also be removed from their context (or *host unit*) and compiled on their own, ultimately winding up in that mysterious library.

When this is done the programmer must supply the information needed to link up the pieces. For instance, suppose our EXAMPLE procedure relied on another procedure called ADA_GREETINGS to print the Countess's felicitations. ADA_GREETINGS might simply be elaborated inside EXAMPLE or, if it is to be separately compiled, its specification is declared inside EXAMPLE like this:

```
procedure EXAMPLE is
   procedure ADA_GREETINGS is separate;
   -- other declarations

begin
-- body of EXAMPLE
end EXAMPLE;
```

The keyboard *separate* is called a *body stub* because it takes the place of the procedure body. Now when ADA_GREETINGS is written its parentage must be included in the specification:

```
separate (EXAMPLE)
   procedure ADA_GREETINGS is
```

In this way, ADA_GREETINGS becomes a *subunit* of EXAMPLE. The genealogical relations between Ada program units, like those in an Irish clan, can become quite convoluted.

Although the top-down method is the reigning champion of programming styles, Ada anticipates a day when the opposite method will be just as common. In the bottom-up scheme, large programs are put together from a set of general purpose building blocks called packages.

An analogy can be found in the construction trade where a slab of prefabricated concrete can be used to build either a ranch house or an auditorium. The TEXT_IO package is an example of this kind of building block. It provides a collection of Ada resources which can be used by different programs in different ways.

Packages

To illustrate the use of packages, suppose that you are part of a programming team that is developing the software for a new video game. Although each programmer is involved with a different aspect of the game, everyone will need access to certain basic procedures and data files. At the beginning of the project these resources would be grouped together in a package, compiled, and placed in a library for use by one and all. Doing this looks a great deal like writing a procedure.

Obviously, the distinction between specification and body is greater with packages than with other Ada program units. In fact, the specification and the body can be (and frequently are) compiled separately. This is in keeping with Ada's philosophy of "everything in its proper place."

Everything that is to be public (i.e., all the resources used by the program units that access the package) goes into the specification, including the specifications of any subprograms contained within the package, such as COLLISION.

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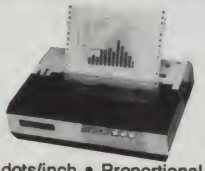

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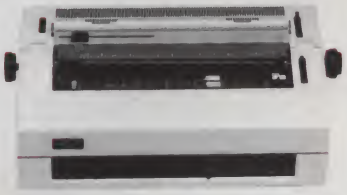

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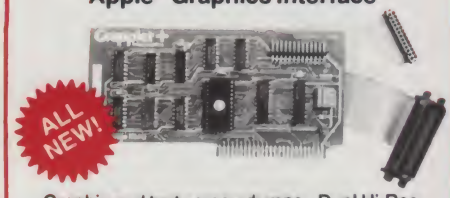

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```
package VIDEO_GAME_ENVIRONMENT is
   -- specification

   SCREEN_WIDTH:  constant integer := 256;
   SCREEN_HEIGHT: constant integer := 190;
   type POS is    record
                  X: integer
                     range 1..SCREEN_WIDTH;
                  Y: integer
                     range 1..SCREEN_HEIGHT;
                  end record;
   GAME_OVER:     Boolean;
   GAME_PRICE:    integer range 25..100;

   procedure GET_ENEMY_COORD (EPOS: POS);
   procedure GET_PLAYER_COORD (PPOS: POS);
   function COLLISION (PLAYER, ENEMY: POS)
            return Boolean;

   end VIDEO_GAME_ENVIRONMENT;
   -- end specification


package body VIDEO_GAME_ENVIRONMENT is
   -- body

   function COLLISION (PLAYER, ENEMY: POS)
            return Boolean is

   begin
   if PLAYER.X=ENEMY.X and PLAYER.Y=ENEMY.Y
      then return true; -- collision
      else return false;
      end if;
   end COLLISION;

   -- similar elaborations of
   -- GET_ENEMY_COORD
   -- and GET_PLAYER_COORD

   begin    -- initialization
   GAME_OVER := false;
   GAME_PRICE := 25; -- cents
   end VIDEO_GAME_ENVIRONMENT;
   -- end of body
```

The contents of the body area available only to the package. Since the inner workings are sealed off from the outside world, the whole package can be changed without affecting any of the program units that access it. This compartmentalization also prevents any tampering—both unintentional and otherwise—that might cause unpredictable results.

Packages may exist on their own or they may be declared within other program units. They may contain data, subprograms, and other packages, all of which may be concealed to varying degrees through the use of the *private* declaration (which won't be discussed here). The initialization section is optional and in our example it could have easily, and more elegantly, been replaced by assignments in the declaration section.

Now that these handy resources have been gathered together in a single package and safely stashed away in a library, how do you—the applications programmer—make use of them?

Using Packages

Suppose that you have written a program that calls the COLLISION routine contained in VIDEO_GAME_ENVIRONMENT. Your program must include the information that the Ada linker needs to locate the package and make its resources available. This is done with the two Ada keywords—*with* and *use*—that were employed to access the

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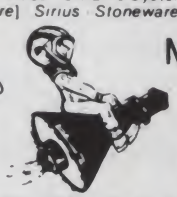

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standard package TEXT_IO. The following is a program that can call COLLISION and use any of the other resources contained in the package:

```
with VIDEO_GAME_ENVIRONMENT;
use VIDEO_GAME_ENVIRONMENT;
procedure PLAY is

E, P: POS;

begin
while not GAME_OVER loop
      GET_ENEMY_COORD (E);
      GET_PLAYER_COORD (P);
      if COLLISION (E, P)
         then GAME_OVER := true;
         end if;
      end loop;
end PLAY;
```

The use of the three subprograms and the POS data type by PLAY would be illegal without the statement "with VIDEO_GAME_ENVIRONMENT." Although it seems redundant to require separate *with* and *use* clauses, this division of labor lets the programmer decide how much of the package is to be made visible. If a package has been separately compiled, a *with* clause must appear before the package can be accessed; *use*, with or without *with*, makes the package totally visible.

If there is no *use*, the identifiers in the package must be preceded by the package name and a dot, just like the components of a record structure. Omitting a *use* in the text of PLAY would make it necessary to re-write the declaration of E and P as

```
E, P: VIDEO_GAME_ENVIRONMENT.POS;
```

and to rewrite the first procedure call as

```
VIDEO_GAME_ENVIRONMENT.GET_ENEMY_COORD(E);
```

Yes, Ada can get wordy. Typically, *with* and *use* are applied separately—a single *with* clause appears at the beginning of a program unit listing all the packages needed, as in

```
with TEXT_IO, VIDEO_GAME_ENVIRONMENT;
```

Then *use* clauses are strategically placed throughout the program wherever a particular package must be totally visible.

There are exceptions, of course, such as the case of a single identifier existing in two currently visible packages. The ambiguity is overcome through the dot notation.

To the Ada novice, this visibility business seems like a big headache. But packages are the heart and soul of Ada, a language that has done more with program organization than any other. A typical Ada program is made up of dozens of little boxes which may be airtight or totally permeable depending on the needs of the programmer. This kind of control requires a great many tools, which is why Ada is such a big language.

Now for the finale: a look at one last Ada topic which will tie together the various threads of the language with special attention to packages and visibility rules.

Generics

Remember the function SUM? There were two versions, one for floats and one for integers. Since the function was so short it wasn't much trouble to write it out twice, even though the two versions were almost identical. But what if it had been 500 lines long?

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The philosophy of Ada is that similar objects should have to be written only once. After such an object is defined, it can be used as a template or archetype for the creation of similar objects. In Ada, the template object (which can be a subprogram, package, data type, or practically anything else) is said to be *generic*. The process of creating a new, similar, object is called *instantiation*. The following is a generic version of SUM:

```
generic        -- specification
   type T is (<>);
   function SUM (X, Y, Z: T);

function SUM (X, Y, Z: T) return T is
begin          -- body
return X+Y+Z;
end SUM
```

The specification tells us what things are to be generic, in this case the subprogram and the data type. The generic *parameter* for type T,<>symbol, is called a *box*. The box is the thing that will alter with each instantiation just like a parameter in a function call. The following examples of instantiation will create our two versions of SUM.

```
function SUM_INT is new SUM (integer);

function SUM_FLO is new SUM (float);
```

We now have two separate functions stamped from a single generic template.

Generics play an important role in Ada. The language itself has few built-in facilities for handling input/output, mathematical computation, and other necessary support functions. Instead, Ada provides a few generic packages which the user must instantiate to meet his own needs. Ada programmers do a great deal of instantiation.

For instance, the text I/O routines used in this article—*get* and *put*—are only defined for use with character data. Why characters and not, say, integers? Although Ada has only one kind of character, the familiar 8-bit ASCII creature, there are theoretically an infinite number of integers including the built-in integer types and all the derived types that a user might dream up.

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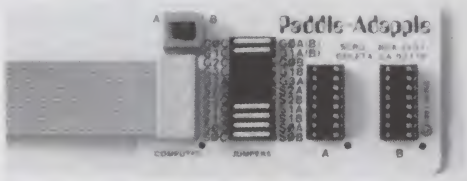

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Yet, the sharp-eyed reader will have noticed that *get* and *put* have been employed with various non-character objects such as integers and enumeration values. I conveniently neglected to mention that none of these examples would have worked without instantiation of an appropriate package. Now that we are familiar with generics, I will make amends.

Along with the Ada language itself, the Department of Defense has provided two support packages—INPUT_OUTPUT and TEXT_IO. The latter contains generic packages (like wheels within wheels) for handling all the predefined data types. These generic packages include INTEGER_IO, FLOAT_IO, and the *pre-instantiated* package CHARACTER_IO. The package specification for enumeration types looks like this:

```
generic type ENUM is (<>);

package ENUMERATION_IO is
   procedure GET (ITEM: out ENUM);
   procedure PUT (ITEM: ENUM;
                  WIDTH:integer := 0;
                  LOWER_CASE:
                        Boolean := false);
end ENUMERATION_IO;
```

ENUM is the generic parameter, which could be matched up with the BEATLE or any other enumeration type; WIDTH and LOWER_CASE are optional formatting controls.

Until this package is instantiated, *get* and *put* will work only with characters. After writing

```
package BEATLE_IO
   is new ENUMERATION_IO (BEATLE);

with BEATLE_IO; use BEATLE_IO;
```

get and *put* are defined (overloaded) for both types. We could write statements such as

```
CHARACTER_IO.PUT ('Z');
BEATLE_IO.PUT (RINGO);
```

but the rules of overloading make it unnecessary since the two PUTs can be distinguished by their arguments. We can get by with

```
put ('Z');      -- implied to be
                -- the PUT in CHARACTER_IO
put (RINGO);    -- the PUT in BEATLE_IO
```

Similarly, if we wanted to do I/O with integers we would have to instantiate yet another package.

```
package INT_IO
   is new INTEGER_IO (integer);

with INT_IO; use INT_IO;
```

Now *get* and *put* are overloaded for three data types. If this hadn't been done, statements such as put (1+1) would be illegal. The same thing holds for floating-point numbers and everything else except characters.

All this instantiation would be a royal nuisance if it had to be done every time you wrote an Ada program. Typically, though, Ada programmers will do it once and put the results in a single package that can be accessed by every subsequent program. This is the beauty of Ada—every programmer can have a customized tool box. Programmer Fred might assemble something like this:

```
with TEXT_IO; use TEXT_IO;
package FREDS_IO_PACKAGE is
   package FREDS_INTEGER_IO
      is new INTEGER_IO (integer);
   package FREDS_FLOAT_IO
      is new FLOAT_IO (float);
   -- and so forth.
```

Programmer Louella might find that Fred's I/O routines were useful in one part of a program while Sally's were appropriate in another. Her program might look like this:

```
with FREDS_IO_PACKAGE,
     SALLYS_IO_PACKAGE;
use  FREDS_IO_PACKAGE,
     SALLYS_IO_PACKAGE;
procedure LOUELLAS_PROGRAM is

   procedure P1 is
   use FREDS_INTEGER_IO;
      begin
      put (1+1);    -- Fred's "put"
      end P1;

   procedure P2 is
   use SALLYS_INTEGER_IO;
      begin
      put (2+2);    -- Sally's "put"
      end P2;

end LOUELLAS_PROGRAM;
```

It could be made even simpler than this.

These are some of the ways that Ada programs can be put together. We have only seen the outlines; the details can become almost microscopic.

Summary

In general, Ada programs can be assembled using either the *top-down* or the *bottom-up* method. The former approach employs *subprograms*—procedures and functions which may be overloaded as often as necessary. Subprograms may be broken down even further by separate compilation of the specification and body.

If the specification is included in another program unit it is called a *body stub*. Bottom-up programming is accomplished with general-purpose *packages*, used for grouping together related resources such as data and subprograms. Like other objects in Ada, packages may be declared as *generic* and used to create similar objects through the process of *instantiation*.

Program organization is the most important feature of Ada. In the future, complex programs will be assembled from Ada modules just as easily as a child builds a house out of wooden blocks. Libraries of software components will exist to satisfy every taste. Need a video game controller? Instantiate it. Your I/O routines are too slow? Here, try Fred's.

Ada will be a big part of the future. If you don't want to be left behind, get your hands on an Ada compiler and start writing programs.

Until next month, when we will evaluate two implementations of Ada for microcomputers, the Countess of Lovelace bids you Farewell! □

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Re-Discovering Level II

Robert Spahitz

Although Radio Shack has replaced its Model I computer with the Model III and Color Computer, I continue to use my Model I, and I suspect that many other people do, too.

This article is written specifically for those who still program on a Model I, Level II, but it may also be of use to Model III users and other programmers as well. It includes some simple programming techniques, a description of how to create an error which should not be (a bug in Radio Shack Basic...still extant in the Model III computer), a mini-review of Radio Shack's *T-Bug* and machine language, a mention of how to put control characters and arrows directly into text (inside PRINT statements for example), and an explanation of how to create sound without any extra peripherals.

Radio Shack Basic includes many unusual idiosyncracies that are rarely mentioned. For example, the Level II manual tells you that you should use THEN with all IF statements, when in reality, THEN is not needed in most cases, and in one case it is always needed. (THEN uses up one extra byte every time it is used, and it rarely makes the program any more understandable.)

If you are comparing only numeric data, THEN is usually needed only when the true part of the IF statement is an assignment with LET omitted. If you are comparing string data, THEN is always required for an ELSE clause to work; otherwise THEN is needed only if the dollar sign is omitted, because the variable being used is predefined in a DEFSTR clause (see Chart for examples).

Also, beware of hidden keywords when you program (Chart examples 12-16), especially when you are doing logical comparisons.

According to the Level II manual, INKEY$ "returns a one character string... the last key pressed." However, some keys do not work the way you might hope, specifically SHIFT, BREAK, and @.

Although there are two shift keys, they have no effect on INKEY$ unless pressed with another key. If that other key is @, program execution freezes. To have the program accept SHIFT @ as data, both keys must be pressed twice.

The other troublemaker is the BREAK key which almost always interrupts the program. To overcome this, POKE 16396,7 will disable the BREAK function and allow that key to act as any other key (CHR$(1)) until execution of POKE 16396,0. By placing these around input statements, you can prevent accidental BREAKing until after data input. Be sure to POKE into 16396 and not elsewhere, or you may not be able to recover your program.

Errors Or Not?

The INPUT statement, although useful, has several problems. If the variable is omitted after INPUT, no error will be picked up if the length of the input entered is zero before ENTER is hit. For example,

510 INPUT or 510 INPUT "HIT ENTER";

work fine if ENTER is hit immediately or if, as an example, HELLO and then five backspaces are typed before ENTER. Obviously this method of input is bad unless you know that the only input will be ENTER; otherwise the computer will try to store the information in the non-existent variable, causing an error. Note: CLEAR can be used to replace backspaces.

Another INPUT problem has to do with the way data from the INPUT are interpreted. It affects both Model I and Model III, presumably because nobody at Radio Shack ever noticed this built-in error. When I first encountered this error, I thought there was a spelling mistake in my program line, because I was put into edit mode after a ?SN ERROR IN LINE xxx. When I listed the line, I saw nothing wrong, so I searched through the rest of my program. I still found nothing, so I ran the program again. After several tries, I found out that my input had caused the error.

Try typing the following program and RUNning it:

```
10 INPUT A
20 PRINT A
30 GO TO 10
```

Robert Spahitz, 143 Dewey Avenue, Staten Island, NY 10308.

Figure 1.

	Entering this input	Should give this response
example 1	5.0	5
example 2	5%	5
example 3	$5	?REDO
example 4	5.0%	?SN ERROR IN LINE 10

By typing any number, you will get either the number printed (or rounded off first) or an overflow if the number is too large. Typing non-numbers or combining numbers and nonnumbers usually gives a ?REDO or ?EXTRA IGNORED message. However, a certain combination gives ?SN ERROR IN LINE 10, and puts you in EDIT mode for line 10.

In example 1 of Figure 1, the computer interpreted the period as meaning floating-point. In example 2, % means integer. In example 3, $ is in no way numeric. In example 4, the computer got confused. If asked what interest rate you will be using in a program, example 4 is a likely response, but the computer picks it up as an error and makes you lose your last 30 minutes of typing.

This error is obviously in ROM because input to a program is not supposed to cause the program to bomb with a syntax error. What causes it?

As far as I know, this error occurs on all Level II and Model III computers whenever a period is followed by a percent symbol but before either a comma or a colon, and if the data is being put into any numeric variable (either directly through INPUT or LET, or indirectly by converting a bad string to numerics). That is, this error will occur if you try to put 5.%, -3.14159%, .1%234, .% or any similar combination into an integer, single or double precision variable, or a string variable of which the program will take the VALue.

Why does this error occur? Apparently, the computer interprets your input character by character after you hit ENTER. When it finds a period, it sets up storage for a floating point number. When it finds % it attempts to store the number as an integer. Since floating point numbers cannot be integers, the computer gets confused and claims that there is something wrong with your INPUT statement, LET statement, or VAL command.

How do I cure this problem? The only way I know to avoid it is to always use string inputs, either with INPUT or INKEY$, then edit out any % and other stray characters using LEFT$, MID$, and RIGHT$ (or do not allow stray-character input when using INKEY$), and finally convert the input to numeric data using the VAL command.

If you are really daring, you can create your own input routine using machine language. Two very useful tools for this are *How To Program The Z80* by Rodnay Zaks, Radio Shack catalog number 62-2066, $10.95 and *T-Bug*, Radio Shack catalog number 26-2001, $14.95.

How To Program The Z80 is a book that tells you exactly that. It has a listing of all Z80 instructions, tells how they work, and describes how to put them together with other instructions to create useful programs. Note: A working knowledge of Basic will help you better understand machine language instructions.

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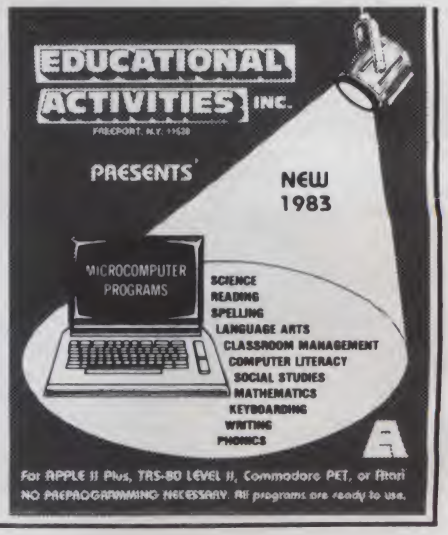

When To Use 'THEN' In 'IF' Statements

Program Line	Works as Expected	Solution
1. IF A=B PRINT C	Yes.	
2. IF A=B C=5	No. Computer interprets B and C as one variable.	Use THEN after B.
3. IF A=B LET C=5	Yes.	
4. IF A=B*5 C=5	Yes!	
5. IF A=5*B1 C=5	No. Similar to number 2.	Use THEN after 1.
6. IF A$=B$ PRINT C$ ELSE PRINT	Yes, if A$=B$; No, if A$≠B$... ELSE clause disregarded.	Use THEN after B$.
7. IF A$=B$ C$="HI"	Yes.	
8. DEFSTR A,B:IF A=B PRINT C	Yes.	
9. DEFSTR A,B:IF A=B C=5	No. Same as number 2.	Use THEN after B.
10. DEFSTR A,B:IF A=B$ C=5	Yes. (A=B$ is correct)	
11. IF E=2 DISC=SQR(B ↑ 2-4*A*C)	No. New variable ISC is created and E is compared to 2D (double precision).	Use THEN after first 2.
12. IF A=T AND F=3 THEN STOP	Yes, *if* there is a space between the first T and the A in AND, otherwise interpreted as IF A=TAN...	Put space after T.
13. IF PM=SE THEN STOP	Similar to above: if space after first E is omitted, interpreted as IF PM= SET...	Put space after E.
14. FOR A=GO TO FINISH	NO! Does not work, even with spaces.	GO must be POKEd into memory; easier to change variable.
15. FOR A=AU TO LE	Only if space after U.	Put space after U.
16. PRINT TAUT OR LOOSE	Yes, with spaces, otherwise keyword AUTO gets in the way of this logical OR.	Put space before O.

Many are very similar to #16, so beware when logical ORing or ANDing.

Notes:

10. IF A=B$ C=5 is not an error.
11. This gave me different results, but the square root is not stored in DISC.

12-16. By leaving spaces after variables that effect the beginning of a keyword, most problems like this are resolved. For example, use =AU TO instead of =AUTO. This will not work when GO is next to TO because the computer disregards spaces, linefeeds and certain other CHR$ codes when trying to form the GOTO keyword.

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Level II, continued...

T-Bug is a Radio Shack creation which allows you to write, edit, and execute machine language programs. It is loaded from cassette and accepts eight different commands.

Along with the *T-Bug* cassette comes a very handy reference manual that carefully explains each command, includes a Level I to Level II conversion program, lists all of the Z80 opcodes and their symbolic names (unfortunately, no description of the commands is included), pictures a memory map of both Level I and Level II memory, lists some useful ROM subroutines (such as getting a character from the keyboard, and using the cassette and printer), contains a conversion table for binary-hexadecimal-decimal numbers, and finally lists some books to read for more information about machine language.

All in all, *T-Bug* is very useful for the machine language novice, but a book on the Z80 is a must if you want to understand the Z80 commands. If you are serious about speeding up your programs and using less memory, $15 for *T-Bug* and $11 for a good book is very reasonable.

Control Characters in Text

Moving along, let us examine a useful aspect of Level II. Through use of the EDIT command, any control character from 1 to 27 can be sneakily stored into one byte instead of the usual four or five bytes needed to store CHR$(NN) where NN would be a number from 1 to 27. This is tricky but worth the effort if you enjoy conserving memory and confusing anyone who reads your listings. The procedure follows:

1. Type the line in which you want the code, leaving one space where it belongs.
2. Enter EDIT mode by typing EDIT line number ENTER.
3. Space up to and over (not past) the space to be changed (usually right after the first quotation mark).
4. While holding down the down arrow, type C and release only the C key.
5. Hold the shift key down.
6. Type the letter of the alphabet corresponding to the code you want printed (A=1 B=2 C=3...Z=26 ↑=27)
7. Release all keys and hit ENTER or E to exit EDIT mode and store the code.

This may sound complex, but it is rather easy once you do it a few times. Try the following example:

```
10 PRINT CHR$(23) "HELLO"
```

To convert the above, first type

```
10 PRINT "HELLO"
EDIT 10 (ENTER)
```

and space past the first quote. Now hold the down arrow key, depress and release the C for change, hold the SHIFT key and type W, the twenty-third letter of the

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Listing 1.

```
10 FOR Z = 1 TO 25
20 A = RND(300) - RND(600)
30 B = RND(300) + 300
40 C = RND(25)
50 D = RND(RND(9))
60 E = RND(RND(9))
70 GOSUB 100
80 NEXT Z : REM MAKE SOUND AGAIN
90 END
100 FOR Y = A TO B STEP C
110 OUT 255,0
120 FOR Z = 0 TO D
130 NEXT Z : REM DELAY
140 OUT 255,4
150 FOR Z = 0 TO E
160 NEXT Z : REM DELAY AGAIN
170 NEXT Y : REM REPEAT CLICK
180 RETURN
```

Listing 2.

```
10 OUT 255,8 : REM CHANGE SCREEN TO
   32-CHARACTER MODE
20 PRINT "T Y P E   A ,   B   O R
   C"
30 A$ = INKEY$
40 IF A$ < "A" OR A$ > "C" THEN 30
50 IF A$ = "A" PRINT "STOP" : STOP
60 IF A$ = "B" PRINT "END"  : END
70 PRINT "END OF PROGRAM"
```

alphabet. If you do not hold the down arrow or type it after the C, your results will not be the same, so do it in the proper order. The down arrow somehow affects the TRS-80 character generation section, so by holding this down with other keys you will produce other characters.

This leads me to my next trick: producing arrows directly in text. This is much simpler than inserting control characters into text and is probably more useful. There are several ways to do this. I find this way easiest:

First depress and hold the Z and 2 keys, then backspace twice to erase the Z and the 2.

Then Press	To Get
3	↑ 3
4	↓ 4
5	← 5
6	→ 6
7	_ 7

Finally, backspace once to erase the number, and you end up with the arrow. No EDIT mode was needed. Note: Sometimes the number comes before the arrow. In that case, just erase the arrow and the number, and try again.

Sound Too?

Finally, I have discovered that the TRS-80 can produce sound without any new software, hardware, or even a speaker. Although you do not get a symphony, you do get hums, buzzes, and clicks. There seems to be a flip-flopping device inside the keyboard that controls cassette input/output. By making it flip-flop at different speeds, you can produce several sounds directly from the keyboard. Since this device directly affects the recorder, it is wise either to turn off the cassette or to unplug the leads before attempting to make sounds.

The command to make sound is the infrequently used OUT statement. See Listing 1 for a sample program. By changing the delays in lines 120 and 150, or by changing the values in line 100, different sounds are produced.

The OUT statement can also be used to change the screen from 64-character mode to 32-character mode or vice versa, but it does this only during program execution. When the program stops, the screen reverts to its original mode. As a programmer, I find this useful because I can run my program in 32-character mode, and when I want to stop and list my program, I do not have to clear the screen, thereby losing any output I may have wanted to examine.

Try the sample program in Listing 2 to see how this works. Some problems do arise with this method, but they are minor. First, if CLS is encountered, OUT 255,8 must be re-executed. Second, all PRINTs that contain literals (anything inside quotes) must be spaced properly to appear on the screen correctly (see line 20 in Listing 2).

Summary

- THEN is not usually needed, but should be included when the true part of IF statement is an assignment, or if strings are being compared.
- INKEY$ does not accept SHIFT as a single character; you must type SHIFT-@ twice to store it; you must disable the BREAK key to be able to store it (POKE 16396,7).
- INPUT does not need a variable, but if you omit it, the only acceptable input is ENTER; if INPUT is used with numeric variables, or the program takes the VAL of a string, the program will bomb if the input contains a period followed by %.
- The EDIT subcommand C can be used to get control characters to be stored directly in text.
- By holding down the 2 and the Z keys, you can get arrows or an underscore directly on the screen by typing 3, 4, 5, 6 or 7.
- Sound can be produced by switching from OUT 255,0 to OUT 255,4 and back, and including delays between them.
- OUT 255,8 will convert to 32-character mode during program execution as long as CLS is not encountered, and stay in that mode until the program is stopped.

I hope you have found these items useful and will include them to make your programs more efficient and, ultimately, more exciting.

If you have questions or comments, I would be pleased to read and respond to any that contain a self-addressed envelope. □

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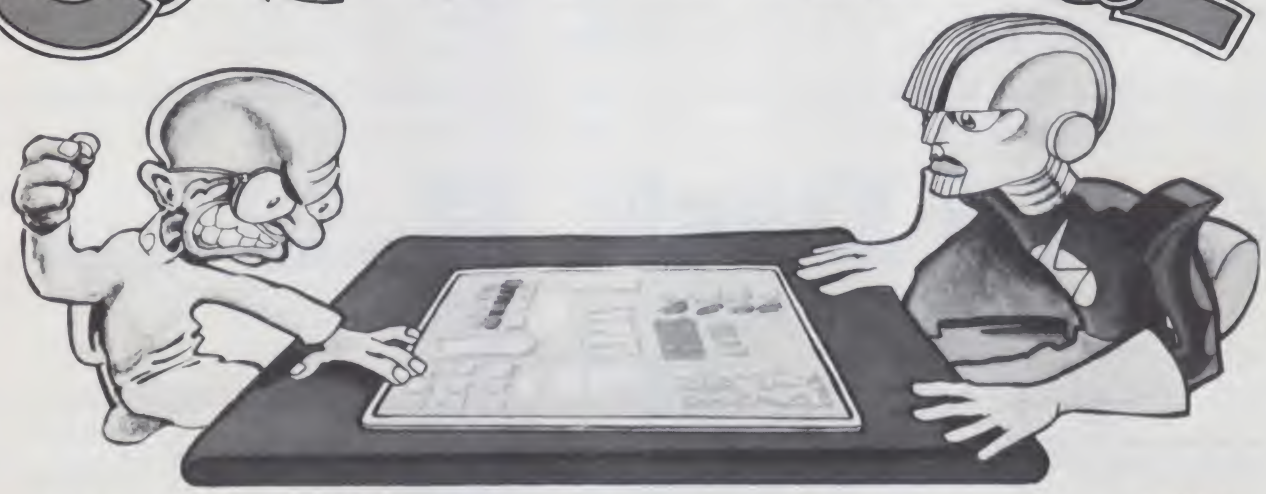

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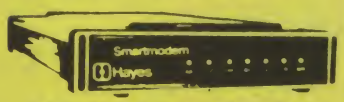

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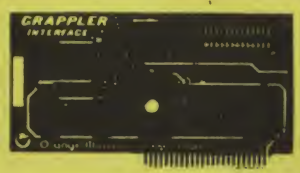

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Pilot Tutorial II

Mike Smith

Last month in "Pilot Tutorial I," the type, match and accept instructions were introduced. This tutorial provides more details on those instructions. Some of the forms of the commands are particular to the Pilot to Basic convertor which appeared in the October 1982 issue of *Creative Computing*. However, most Pilot implementations will have commands to equivalent things.

Extending The Type (T:) Instruction

When writing a lesson you often need many display functions in addition to typing individual lines. You need to clear the screen, decide where to put your text, and add emphasis to what you say.

Clearing the screen and then typing a line is achieved by the screen clear command TC:

```
TC:THIS LINE WOULD APPEAR AT THE TOP OF THE SCREEN
```

Moving the cursor down the screen is achieved with the vertical tab command TV:, followed by a number between 1 and 20.

```
TV:5   Move the cursor to the 5th line on the screen.
```

Emphasis can be achieved by typing a line in *inverse* (i.e. black letters on a white background) using the command TI:

```
TI:THIS LINE WOULD BE IN INVERSE.
```

Further emphasis can be acheived by combing the TI: command with TH: which deletes the carriage return at the end of the line.

```
TH:PART OF THIS LINE WOULD BE IN

TI:INVERSE
```

Dr. Mike Smith, 304, 86th Avenue SE, Calgary, Alberta, Canada T2H 1N7.

The Type-and-Hold command (TH:) can be used to get the student's answer on the same line as the question asked. This makes for a much tidier, and therefore more readable screen.

```
TH:WHAT IS YOUR NAME?
A:
```

Extending The Accept (A:) Instruction

In the previous tutorial we showed how to accept a student's answer.

```
T:WHAT LESSON DO YOU WANT?

A:
```

This answer could then be used in a match instruction to be compared with what was expected.

In many cases however, the instructor is more interested in reusing the student's response than in checking it. For example, you might want to use a student's name later in a lesson. In this case you need to store it.

```
TH:WHAT IS YOUR NAME?

A:$N1$

M:FRED

T:HI THERE $N1$

TN:WHERE'S FRED?
```

In this program, the student's answer is stored in memory under the label $N1$. The student's answer is then compared to FRED in the match instruction. Next, the student's name is reused in a type statement to make the computer response more friendly. Finally the last line tries to find out where FRED is if FRED has not signed in.

The student's answer can be stored using any name. The

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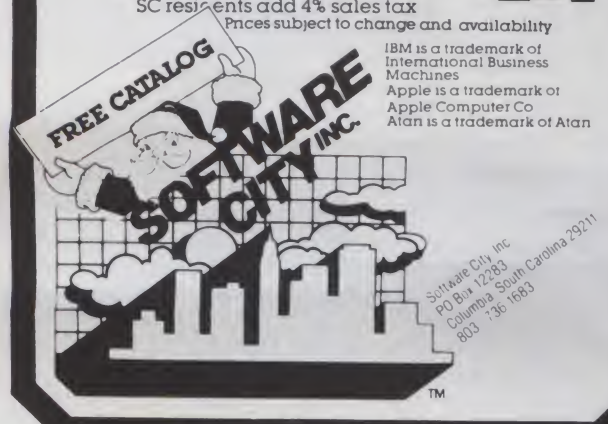

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name must start and end in a $ each time it is used. A caution must be expressed however. The Pilot to Basic translator described earlier turns the Pilot lesson into a Basic program. This means that the part between the dollar signs must be a valid Basic name. On the Apple, you can use two letters or a letter followed by a number. Longer names can also be used, but the Apple will not know what to do with the extra letters. It will ignore them unless they happen to form a Basic language word, in which case it complains (SYNTAX-ERROR). Other versions of Pilot may impose other restrictions.

Using longer names, however, makes things much easier to understand. For example, which program better shows what is happening?

```
T:WHAT IS YOUR NAME?

A:$N1$
```

or

```
T:WHAT IS YOUR NAME?

A:$NAME$
```

To me the second version is so much clearer that I recommend using longer and more descriptive names even if an occasional problem crops up. However, while learning Pilot keep to the simpler names. These are the problems to look out for:

The dreaded siamese twin names. Most Basic translators of Pilot consider only the first two letters of a name to mean anything. You can type more than two letters in a name, but they are ignored. This means that names can look different but be the same. For example $N1$, $N10$, $N100$, and $N1000000$ are all equivalent to $N1$, and $STUDENTS$, $STRENGTHS$, and $STAR$ are all equivalent to ST.

The hidden Basic command. This is a name that has hidden inside it a Basic command. Some examples of hidden names are $LONG$, which contains the Basic command ON; $LENGTH$, which contains the command LEN; and $VALUE$, which contains the command VAL.

This is the same problem that Basic program writers suffer. To avoid it, simply use names that start with a letter followed by a single number. Use the longer names, knowing that occasionally you will have to go back and change. You will quickly find which of your favorite words cause problems.

Extending The Match (M:) Instruction

In the same way that the accept and type instructions can use a stored name, so can the match instruction.

```
*:START

T:TYPE IN THIS SERIES OF LETTERS  6THGFD34$$%

R:TYPING SKILLS TEST

A:$TEST$

T:TRY AGAIN

A:

M:$TEST$

TY:YOU DID THE SAME THING BOTH TIMES

E:
```

The Link (L:) Instruction

This allows one Pilot lesson to call another. It is used to connect separately written Pilot lessons into one longer lesson. Thus team authoring and modular courseware development become practical.

L:NEXT LESSON would cause the lesson named NEXT LESSON to run.

The User (U:) Command

In many lessons, the instructor needs to repeat an instruction many times. Rather than continually retyping that part of the lesson, the user Instruction can be used. For example, suppose that after typing some information for the student you want to pause until the student is ready. The lesson might look something like this

```
*:START
R:FIRST TEXT PAGE
...
...
U:PAUSE
R:SECOND TEXT PAGE
...
...
U:PAUSE
R:ETC
...
...
E:END OF MAIN LESSON
*:PAUSE
T:
TH:TYPE RETURN TO CONTINUE
A:
E:
```

When the program reaches the U:PAUSE command, it stops that part of the lesson and uses the lesson part called PAUSE. When it has finished PAUSE, it jumps back to where it came from and continues the lesson until it reaches the next U: command.

You should notice that the user routine starts *after* the end (E:) command that shows the end of the main lesson. At the end of the user routine there is a second end command. You need an E: at the end of the main lesson and, if you are using user commands, an E: at the end of each user lesson part to separate them.

The Basic (B:) Instruction

Most of the time, the simple Pilot commands are sufficient. Occasionally however, it would be nice to do something else. This command allows any valid Basic command to be included into a program.

Probably the most useful Basic command in Applesoft is the one to control the speed at which the text is printed on the screen. People used to computers like the information to appear on the screen instantly, all at once. Students in my classes appear to prefer the words to appear more slowly. The command B:SPEED 100 will slow the print speed down. High numbers (up to 255) give a faster print. However, once the students are familiar with the computer, they like things to go faster. The problem is how fast? The following PAUSE user routine shows how to use the Basic statement to control the speed of the text printing using the paddles

```
*:PAUSE
TH:PRESS RETURN TO CONTINUE
A:
B:SPEED = PDL(0)
E:
```


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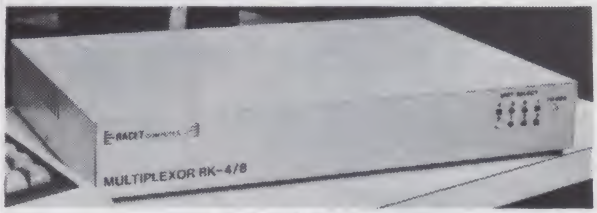

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THE most popular Microcomputer Word Processor in the world now available on the NEC!!! With many added features. Embedded print commands. Print from memory and disk!! Settable tabs. Indent and hanging indent. Parallel, Serial, and Video drivers. DICTAMATIC cassette control for translating dictated messages!! And much more!!! Most features of word processors costing five times as much!!! Runs on 32K or 64K system!!! Works in multi-user environment with the RK4/8 Multiplexor!!!!

★ NEW ★ ELECTRIC SPREADSHEET ★ ★ $75

A BASIC Spreadsheet program for the PC-8001. Anything you work with columns and rows and a calculator belongs on the Electric Spreadsheet. Results formatted for screen or printer. 'What if' questions answered. P/L forecast. Personal budget. Real estate investment. Net worth forecast. Cash flow estimates. Business forms. Works on 32K or 64K system!!! 70 operators plus histogram plot, revise spreadsheat layout, and more. Select preprogrammed operators for line, column, or cell calculations. Set column widths and number of decimals. Manual and diskette include 22 examples.

★ NEW ★ ADVANCED PROGRAMMING BASIC ★ ★ $60

THE functions and commands in this package give you extended control over data and your PC-8001 system. These extensions to NBASIC provide complete conversion of time and date functions including days between dates and Julian dates. Extended string functions include justify, truncate, center, rotate, translate, shift, pack, and search. Array functions include masked search of both sorted and unsorted arrays, and insert in sorted arrays.

MULTI-KEY SORT "MKS" $60

SUPER FAST Machine Language In-Memory Sorts. Three key sort on 500 elements in 4 seconds!!! Simple one-line BASIC functions - SORTV and SORTC VERBS. Mixed ascending and descending keys.

BASIC PROGRAMMING UTILITIES 'BASUTIL' $60

COMPRESS, EXPAND, PRETTY, XREF Cross Reference Utility. Great for modeling, debugging and structuring BASIC programs.

KFS-80 KEYED FILE SYSTEM 'KFS-80' $150

MACHINE language BASIC ISAM utility provides keyed and sequential access to multiple files. Simple interface to BASIC. Binary tree keyed-file index system provides rapid access to records

CONVERT TRS-80* PROGRAMS TO RACET NECDOS WITH 'PROTRAN' $99.95

COMPLETE utilities for file transfer and BASIC program conversion. MOD III diskettes may be read directly; MOD I and II via RS-232. Transfer BASIC programs, data files, or machine language files. NO SUPPORT is provided for conversion of machine language files or PEEK's, POKE's or USR's to function on PC-8001. Substantial knowledge of TRS BASIC and NBASIC required. Package designed for software authors.

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CIRCLE 290 ON READER SERVICE CARD

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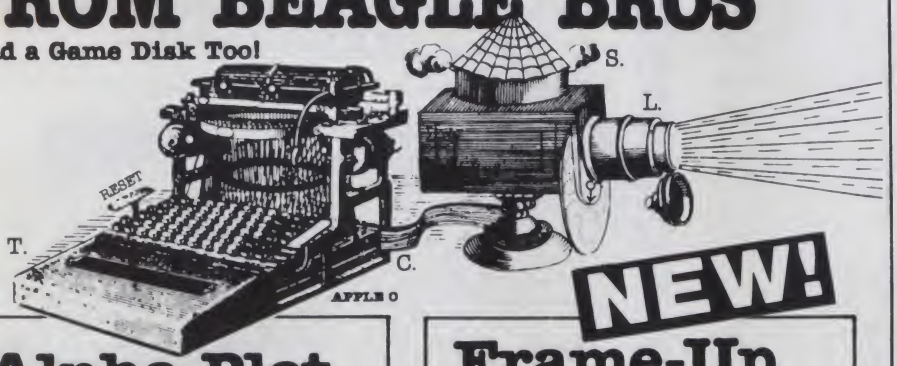
And a Game Disk Too!



NEW!

Alpha Plot

Hi-Res Graphics/Text Utility by Bert Kersey & Jack Cassidy

Here are a few of Alpha Plot's useful graphics features. Compare with other graphic utilities at any price—

HI-RES DRAWING: Create hi-res pictures and charts with text, on both pages; all Optional Xdraw cursor (see lines before drawing). Mix colors & Reverse (background opposite). Circles, Boxes, Ellipses; filled or outlined. **Compress Hi-Res to 1/3 disk space.** Relocate any portion of an image anywhere on either page. Superimpose too & convert hi-res to lo-res for colorful abstracts!

HI-RES TEXT: Beautiful upper/lower case with descenders (no hardware required). Color and reverse characters positionable anywhere (no vtab/htab limitations). Professional-looking **proportional spacing** and adjustable character height and letter spacing. Sideways typing for graphs too!

$39.50

- ☐ Unprotected disk (48K min.)
- ☐ Beagle Bros Apple Tip Book #4
- ☐ Peeks & Pokes Chart

NEW!

Beagle Bag!

12 Games on One Big Disk by Bert Kersey

Twelve great games from our classic Beagle Bros collection—TextTrain, Slippery Digits, Wowzo, Magic Pack, Buzzword... Almost all of our "Game Pack" games have been updated and re-released on one jam-packed unprotected disk! **ALSO INCLUDED** is our "Beagle Menu" greeting program (description under "Typefaces" disk on this page).

Compare Beagle Bag with any 1-game locked-up disk on the market today!

All 12 games are a blast, the price is right, the instructions are crystal clear, AND the disk is copyable! You can even list the programs to see what makes them tick!

$29.50 Unprotected. Paddles NOT required. Beagle Menu works with all normal-DOS disks. Includes Peeks/Pokes Chart.

Frame-Up

Graphics Display Utility by Tom Weishaar

Frame-Up is a very-high-speed Apple "slide projector" utility that lets you create professional-looking displays of intermixed hi-res, lo-res and text pages **on any Apple.** Frame-Up is very easy-to-use and above-all **FAST,** allowing you to load hi-res pictures, for example, in **2½-seconds;** that's five-times faster than normal! Paddles or keyboard are used to change images in forward or reverse order, skipping pages if you want. OR presentations may be left unattended, with **each page individually timed** to appear and remain on the screen from 3 to 99 seconds, as you choose.

Frame-Up includes a sophisticated black and white **text screen editor** that lets you create text "slides" as part of your show. You can even add type "live" on the screen during your presentations. Up to 17 hi-res or 136 lo-res/text pages may be stored per disk. One or two drives are supported. The order and timing of your graphics and text images may be easily (and instantly!) arranged and rearranged. Frame-Up includes a **display module which may be copied** and distributed to your associates so they can run your display, as you designed it, on their Apple or ANY Apple!

Frame-Up is ideal for store displays, presentations to the boss, club programs, trade show booths, product demos, promotions, seminars, conventions, classes, and so on.

$29.50 Machine language. Unprotected. 48K minimum. Peek/Poke Chart included.

BEAGLE BROS DISKS ARE UNLOCKED AND UNPROTECTED. THIS MEANS EVERY PROGRAM IS INSPECTABLE, CUSTOMIZABLE, IF YOU WANT, AND COPYABLE, GIVING YOU THE MOST FOR YOUR SOFTWARE DOLLARS. DON'T SETTLE FOR LESS.

Beagle™ Bros MICRO SOFTWARE

4315 Sierra Vista, San Diego, Ca 92103
714-296-6400

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Apple® Mechanic

Shape Writer/Byte-Zap Utility by Bert Kersey

Another best-selling multiple-utility disk—Nine useful, listable, copyable and customizable programs—

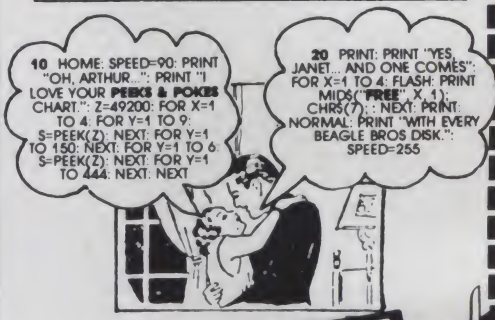
SHAPE EDITOR: Put professional hi-res animation in your programs. Keyboard-draw any shape and let your Apple write a shape table and store it on disk. Design large and small **custom typefaces** too, with special characters. 6 fonts on the disk. LISTable demos show how to use shape tables to animate games, graphic displays, and attractive Charts & Graphs. A valuable time-saving utility/learning tool.

BYTE ZAP: A MUST utility. Rewrite any byte on a disk by loading a sector onto the screen for inspection. **Hex/Dec/Ascii** display optional. Examine bytes via cursor control; enter hex, dec or ascii to change. Create illegal filenames, restore deleted files, change greeting program names, repair/protect disks, change DOS, examine program files. Clear illustrated instructions show how disk data is stored and how to access it. Very educational.

MORE: A disk PACKED with useful music, text and hi-res tricks **for use in your programs.** A great demo-writer program, useful hi-res utilities and educational, entertaining documentation.

$29.50

- ☐ Unprotected disk (48K min.)
- ☐ Beagle Bros Tip Book #5
- ☐ Peeks & Pokes Chart



NEW!

Typefaces for Apple Mechanic

Here are more hi-res fonts for Apple Mechanic's Xtyper and Hi-Writer programs—26 of them at last count, both large and small, all **proportionally-spaced** and positionable anywhere on either hi-res screen. Most are **full 96-character fonts** many with special graphic characters. Each character (from "!" to "□") of every font (from "Ace" to "Zooloo") is, of course, editable with Apple Mechanic's Font Editor.

BONUS: Here's BEAGLE-MENU! A unique greeting program that displays **only the catalog file names you want** on the screen (for example, only locked-Applesoft files, or only Binary files) for one-key cursor selection. Just hit Return to Run, Brun or Exec the program at the cursor. Many other features— Space-on-Disk, Load/Bload option, forward and backward catalog "scrolling" for easy file location, and optional sector-number elimination. PLUS the ability to **swap file names** in your catalog!

$20.00 Unprotected. Beagle Bros' Apple Mechanic disk is required to utilize the type fonts. Beagle-Menu works with all normal-DOS 3.3 disks.

If you don't find our products at your Apple Dealer, tell him to phone Beagle Bros, 714-296-6400, **OR** his favorite software distributor.

If you don't find our products at your Apple Dealer, tell him to phone Beagle Bros, 714-296-6400, **OR** his favorite software distributor.

NEW!

Flex Text

70-Column Text Utility
by Mark Simonsen

Flex Text is a unique utility that lets you print variable-width text on Apple's hi-res screens in normal 40-column format, 20-column expanded or 56- and **70-column condensed** characters. Character widths may be mixed as you like for emphasis. Flex Text understands **normal Applesoft** Basic commands, including Home, Inverse, Normal, Vtab 1-24 and **Htab 1 through 70**! It also supports text window pokes and scrolling, so you can program normally, but with the **ability to add text to graphics**, or *graphics to text*! You can even run your existing programs using these features!

Flex Text is easy to use; just boot it and go! You can now display **upper and lower case** characters in any width without hardware. Every keyboard character may be redefined as any symbol you like with a custom text **character editor.** You may toggle between the "normal" text screen and both hi-res pages if you like. Flex Text is **completely compatible** with Neil Konzen's Program Line Editor and G.P.L.E.

$29.50 Machine language. Unprotected. 48K min. Peek/Poke chart included. Condensed character display requires a monitor (instead of a tv) for best results.

```
10 REM HI-RES NUMBER GENERATOR
20 SIZE=5: SCALE=SIZE: REM NUMBER-HEIGHT
30 HGR: HOME: POKE 232, 0: POKE 233, 3: ROT=0
40 FOR A=768 TO 830: READ B: POKE A, B: NEXT A
50 N=N+1: N$=STR$(N): X=99: Y=0
60 FOR A=1 TO LEN(N$): HCOLOR=0: DRAW 8 AT
   X, Y: HCOLOR=3: DRAW VAL(MID$(N$, A, 1))
   AT X, Y: X=X+SIZE+SIZE: NEXT A: GOTO 50
70 DATA 20, 0, 24, 0, 27, 0, 31, 0, 35, 0, 39, 0, 44, 0,
   49, 0, 52, 0, 57, 0, 53, 62, 36, 0, 49, 38, 0, 53,
   55, 61, 0, 53, 23, 37, 0
80 DATA 46, 38, 52, 0, 61, 46, 62, 5, 0, 61, 54, 37, 7,
   0, 53, 38, 0, 54, 37, 60, 46, 0, 53, 39, 53, 62, 5, 0
```

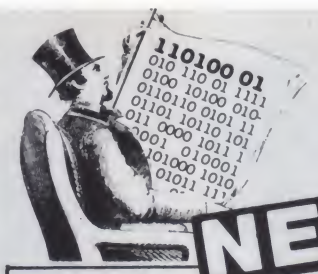
DOS Boss

Disk Command Editor
by Bert Kersey & Jack Cassidy

A classic Apple utility you will ENJOY! Rename DOS commands ("Catalog" can be "Cat", etc.). PROTECT PROGRAMS; any unauthorized save- attempt produces a "Not Copyable" message. Also **List-prevention** and 1-key program-run from catalog. Custom catalogs: Change Disk Volume message to your title; Omit or alter file codes. Rewrite error messages: "Syntax Error" can be renamed "Oops!!" or anything you want! **Two books included**— Fascinating documentation and hours of good Apple reading!

Dos Boss's change features may be appended to your programs so that anyone using your disks (booted or not) formats DOS as YOU designed it.

$24.00
- ☐ Unprotected disk (32K/48K)
- ☐ The Dos Boss Book
- ☐ Beagle Bros Apple Tip Book #2
- ☐ Peeks & Pokes Chart



NEW!

Before you buy any Apple game disk, compare features:

Is there more than one game? Beagle Bag features TWELVE unique games on one disk PLUS a bonus greeting-program utility for use on all of your existing 3.3 disks.

Can it teach programming skills? Beagle Bag games are listable so you can see what makes them work. You can even CHANGE each game's features if you want.

Is the disk copyable? Beagle Bag can be backed-up with ANY copy program. Don't buy software that can't be backed up!

Is the disk unlocked? The Beagle Bag disk can be catalogged, loaded-from, saved-to and Fidded, making it more flexible and more FUN than any locked-up One-Game disk on the market today.

Is the disk priced right? Counting the bonuses, Beagle Bag costs less than $2 per program. This is a disk that will "earn its keep" as long as you own your Apple!

BEAGLE BAG $29.50
(See description on previous page.)

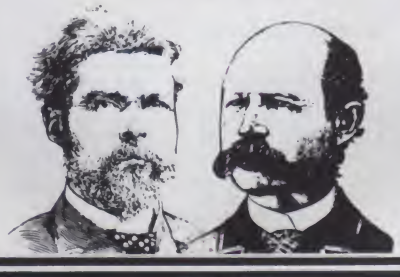
Tip Disk#1

100 Tip Book Tips on Disk
by Bert Kersey

100 programs from Beagle Bros' Tip Books 1, 2, 3 and 4— Fascinating tricks to make your Apple do things it's never done before! All 100 programs are listable, copyable and changeable; and each teaches another fascinating Apple programming technique. **Two different charts are included.**

$20.00
- ☐ Unprotected (32K/48K)
- ☐ Peeks & Pokes Chart
- ☐ Apple II Command Chart

BEAGLE BROS DISKS ARE UNLOCKED AND UNPROTECTED. THIS MEANS EVERY PROGRAM IS INSPECTABLE, CUSTOMIZABLE, IF YOU WANT, AND COPYABLE, GIVING YOU THE MOST FOR YOUR SOFTWARE DOLLARS. DON'T SETTLE FOR LESS.



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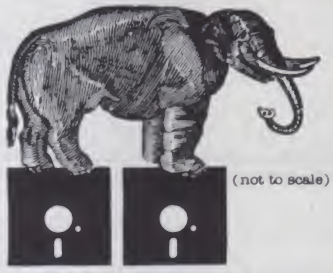
Utility City

21 Utilities on One Disk
by Bert Kersey

A best-seller since it hit the market, and a MUST for your program-development library. Take a look at the features— **List Formatter** makes properly-spaced & indented listings with page breaks; each statement on new line, if-thens and loops called out; a great de-bugger! **Multi-Column Catalog** in any page-width to any printer or CRT. Auto-post Run-Number and last-used Date in programs. Put INVISIBLE working commands in your listings. Access program lines in memory for repair & illegal alteration. Alphabetize & store info on disk. Run any program while another stays intact. Renumber to 65535. Save inverse, trick and **invisible file names**. Convert dec to hex & binary, or Integer to FP. Append programs. Dump text screen to printer...

21 LISTABLE UTILITIES TOTAL!

$29.50
- ☐ Unprotected disk (48K min.)
- ☐ Beagle Bros Apple Tip Book #3
- ☐ Peeks & Pokes Chart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OR ORDER BY MAIL—

RUSH! The disk packages checked below plus the free 11x17 Peeks & Pokes Chart:

☐ Alpha Plot	$39.50	☐ Frame-Up	$29.50
☐ A.Mechanic	$29.50	☐ Tip Disk#1	$20.00
☐ Beagle Bag	$29.50	☐ Typefaces	$20.00
☐ DOS Boss	$24.00	☐ Utility City	$29.50
☐ Flex Text	$29.50		

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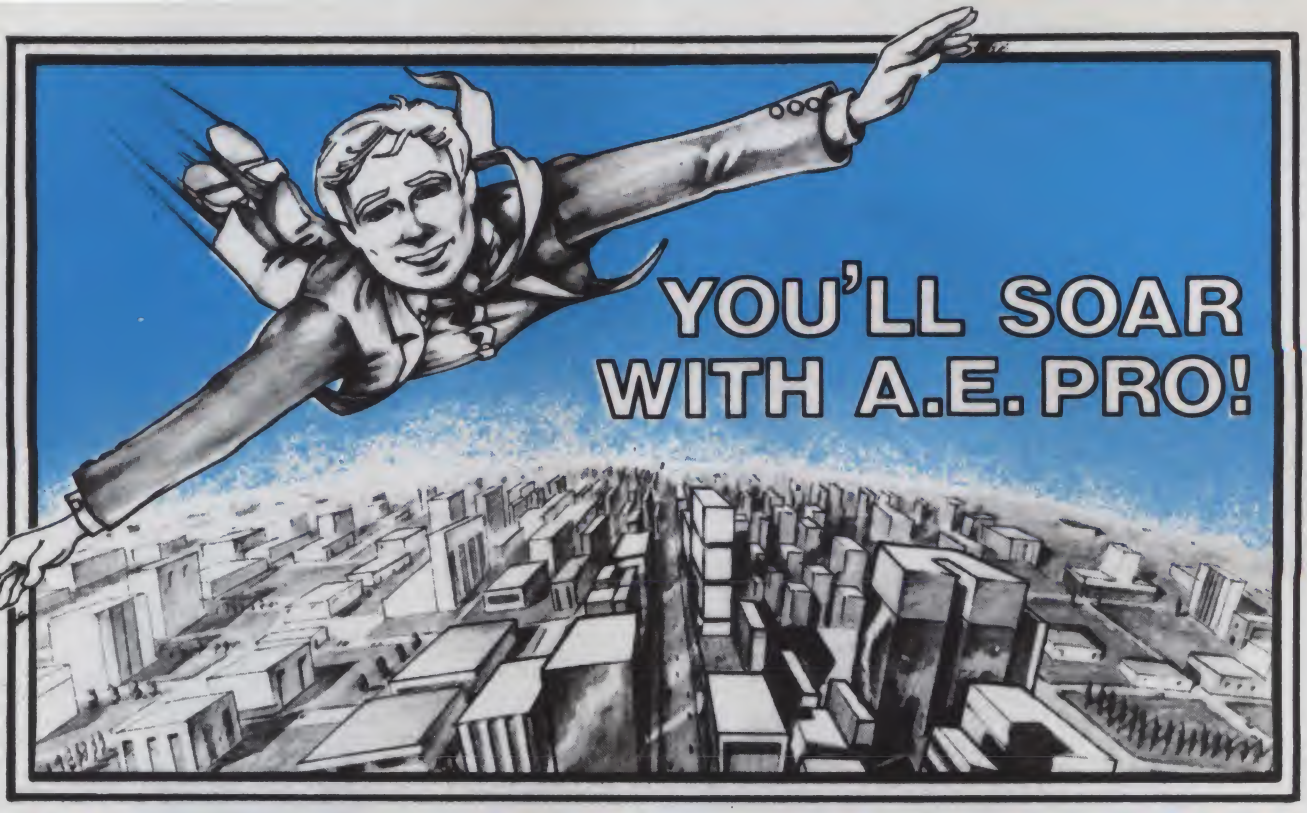
CIRCLE 124 ON READER SERVICE CARD



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- **First** to provide terminal emulation in Apple communications software

Once again, SOUTHWESTERN DATA SYSTEMS creates a software package so far advanced, so innovative, that there are no comparisons.

A.E. PRO (ASCII Express "The Professional"™) truly sets new standards!

Literally thousands of man-hours of work and study have produced the first data communications package that fully utilizes the potential of your Apple Computer System. What does this mean to you?

COMPLETE HARDWARE COMPATIBILITY

Only A.E. PRO takes full advantage of ALL current modem devices available for the Apple II.

Only A.E. PRO supports ALL 80 column boards for the Apple II.

Only A.E. PRO supports ALL printer cards for the Apple II.

This means ALL communications interfaces, ALL printer interfaces, and ALL display interfaces including 80 column cards and external terminals. It couldn't be simpler.

Speeds of up to 9600 Baud are supported, including 110, 300, 1200 and Baudot.

EASY DATA TRANSFER

Data transfer is what communications software is all about. A.E. PRO lets you send and receive with equal ease.

A simple dual key stroke will direct incoming data to its large, up to 28K "capture-buffer", your printer, (with no character loss), or both simultaneously. The buffer can then be written to disk, printed or edited with A.E. PRO's versatile built-in editor.

Data larger than the capacity of the buffer can be saved in buffer-sized "chunks" by use of the auto-save feature, an extension of the popular XON/XOFF protocol used by most main frame computers. As your Apple's memory fills up, A.E. PRO signals the host to pause (XOFF), writes the buffer to disk, and then directs the host to resume sending (XON).

Prices and specifications subject to change without notice.

ERROR FREE TRANSFERS

A wide range of send modes is provided. Everything from the simplest blind block dump, to a packet-oriented error checking mode ensures quick and easy error-free transfer of all sorts of data to practically any host computer. Even the slowest or most awkward systems are easily accommodated.

When two A.E. PRO's are used, you can SEND OR RECEIVE FILES OF ANY TYPE OR SIZE with complete error checking.

POWERFUL MACRO SYSTEM

A.E. PRO supports up to 26 complete macro libraries (remember, S.D.S. pioneered communications macros). Each library contains all macro strings and configuration parameters (baud rate, duplex, parity, etc.) unique to a specific host.

With A.E. PRO's macro facilities you can, with simple keystrokes, direct it to automatically call another computer, connect, and perform complete log-on sequences, virtually instantaneously.

SOPHISTICATED TERMINAL EMULATION

With A.E. PRO, your Apple can "mimic" the display characteristics of many popular terminals, including ADDS, Data General, DEC, Hazeltine, HP, IBM, Lear Siegler, Soroc, Televideo, and many others.

BUILT-IN TEXT EDITOR

A.E. PRO contains a versatile built-in text editor that can easily create or manipulate text. In fact, this editor is more flexible in many respects than some being touted as "word processors". It provides the ease of use of a line oriented editor, with the line editing power of many screen oriented editors, and will process files of up to 35K in size!

RELIABLE UNATTENDED OPERATION

A.E. PRO allows completely unattended answer mode with password protected log-on. In this mode, the caller can remotely send or receive files of ANY type or size.

A.E. PRO can also function as an answerback DDD or TWX node to forwarding mail systems such as Telenet's Telemail, and many others.

A.E. PRO is a member of a family of programs, which include P-TERM "The Professional"™ for Apple Pascal and Z-TERM "The Professional"™ for Apple CP/M™. All three packages share many of these powerful features and operate nearly identically.

For more information write or call us for your free copy of our product catalog and software comparison guide, which include detailed information on all "The Professional"™ series software.

A.E. PRO and other "The Professional"™ series packages are now in stock at local dealers everywhere.

Suggested Retail Price:

ASCII Express	**$129.95**
P-Term	**$129.95**
Z-Term	**$149.95**

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CIRCLE 330 ON READER SERVICE CARD

Most of the time, Basic commands should be avoided as they are unnecessary and require knowledge of Basic.

The Boolean Algebra (X:) Instruction

Despite its strange sounding description, this is a rather useful instruction when you know how to use it. This instruction simply checks to see if something is true or false.

A good use for it is in a lesson in which you want to give a student several chances to answer a question before giving him the correct answer. In the lesson below, the student is given two attempts

```
*:START
R:START THE COUNT
B:COUNT = 0
*:VOWELS
T:GIVE ME A VOWEL
A:
M:A,E,I,O,U
JY:NEXT LESSON
B:COUNT = COUNT + 1
X:COUNT < 3
JY:VOWELS
TN:THE VOWELS ARE A, E, I, O AND U
*:NEXT LESSON
...
...
```

"Hello, Dear! I bought a personal computer today. I'm tired of you always quoting your office unit to me."

In this lesson we have combined the Basic (B:) and the Boolean algebra (X:) to cause a count to occur. The X: command near the end, checks to see if the number of answer tries is less than 3. If that statement X:COUNT<3 is true then the next JUMP instruction takes you back to try again. Otherwise the correct answer is given.

Other uses of the B: and X: commands are to count how many answers the student is getting right. You can then decide to branch back and do a review if the percentage gets too low.

Extending The Jump (J:) Instruction

In Tutorial II, the jump instruction was used to jump another named part of the lesson. If you do too much jumping, you can get so many names that you forget what is what (and don't really need to remember once the label is used). In this case you need local labels.

A local label is a name for a part of a lesson that the computer forgets as soon as it meets a real label. This is easier to do than it is to describe.

Suppose we have two lessons, VOWELS and NUMBERS. In each lesson we want to allow the student three attempts to give the correct answer. Using the instructions from before, we could do this

```
*:VOWELS
B:COUNT = 0
*:VOWELS LOOP
T:GIVE ME A VOWEL
A:
M:A,E,I,O,U
JY:NUMBERS
B:COUNT = COUNT + 1
X:COUNT < 3
JY:VOWELS LOOP
T:THE VOWELS ARE A, E, I, O, U
R:
*:NUMBERS
B:COUNT = 0
*:NUMBERS LOOP
T:GIVE ME A NUMBER BETWEEN 1 AND 5
A:
M:1,2,3,4,5
JY:NEXT LESSON
B:COUNT = COUNT + 1
X:COUNT < 3
JY:NUMBERS LOOP
T:YOU COULD HAVE GIVEN ME  1, 2, 3, 4 OR 5
*:NEXT LESSON
```

In this lesson, the lesson start instruction (:) was used five times. This causes two problems. First, this version of Pilot can only remember 40 names of lesson parts with a few jumps, you could run out of memory. Second, each use of the *: command slows the Pilot-to-Basic program down, as it has to search to make sure that you don't use a lesson name more than once. This is, of course, unimportant as we all know that courseware developers have plenty of time.

We can improve things by using local labels.

```
*:VOWELS
B:COUNT = 0
1T:GIVE ME A VOWEL
A:
M:A,E,I,O,U
JY:NUMBERS
B:COUNT = COUNT + 1
X:COUNT < 3
JY:1
T:THE VOWELS ARE A, E, I, O, U
R:
*:NUMBERS
B:COUNT = 0
1T:GIVE ME A NUMBER BETWEEN 1 AND 5
A:                    <-
M:1,2,3,4,5
JY:NEXT LESSON
B:COUNT = COUNT + 1
X:COUNT < 3
JY:1
T:YOU COULD HAVE GIVEN ME  1, 2, 3, 4 OR 5
*:NEXT LESSON
```

The difference between this lesson and the previous one is the introduction of the number 1 before two of the type statements where before there was an additional *: command. These numbers mark a Pilot command. This means you can jump to a marked instruction. You can mark instructions with the numbers 1 to 9.

Normal lesson names must be unique, i.e., used only once in a lesson. However, you will notice that two instructions have been marked with the same number (1). This is allowed because marks are local labels. When the computer reaches the instruction *:NUMBERS it forgets about all the marking it has done to this point. This means that the mark 1 nine lines above no longer exists in the memory of the computer. You can therefore use the mark 1 again after the line *:NUMBERS.

Whether you use local labels (marks) or lesson part names is up to you. In a short lesson, where you will not run out of memory, it makes no difference. In a long lesson, by personal preference, I use both. The lesson part names break the lesson up into major parts, while I use the marks for jumping around inside each of those parts.

Graphics Commands

GO: Clears the graphics screen and sets the color to white.

GQ: Quit Graphics mode. On the Apple, in graphics mode only the last four lines of the screen are used for text. This command uses all the screen for text.

GC: Clears the graphic screen. No color change.

GS: Displays a hi-res picture on the screen. For example, GS:WORLD would cause the picture PIC.WORLD to be displayed.

GP: Draws a spot on the screen. The bottom left-hand corner of the screen is 0,0. To make things easier for drawing the top right-hand corner of the screen is called 100,100. This means the screen is 100 units wide and 100 units long. To get a spot in the center of the screen type GP:50,50. The adjustments to get the spot in the correct place are made by the Pilot-to-Basic program.

Color is automatically set to white by the program. Other colors can be set using the Basic command as in

B:HCOLOR = ###

where ### = 0 for black 4 for black
1 for green 5 (TV dependent)
2 for blue 6 (TV dependent)
3 for white 7 for white

The actual colors and shades of white depend on the TV and the point being plotted. These numbers make the correct colors in Applesoft.

GL: Draws a line from the last spot on the screen to this spot. For example to draw two boxes, one inside the other

```
*:DRAW TWO BOXES
GO:
R:BOX 1
GP:5,5
GL:95,5
GL:95,95
GL:5,95
GL:5,5
R:BOX 2
GP:30,30
GL:30,70
GL:70,70
GL:70,30
GL:30,30
GQ:
E:
```

If you want to do some really fancy graphics you should read *Graphics Software for Microcomputers* by Korites, published by Kern. The software is written in Basic and generates surfaces, rotating solids, etc. It might be a good addition to Pilot if the routines were turned into Pilot commands.

The Sound (S:) Command

Like graphics, the sound command is not very well implemented. You need a sound editor to properly test what you have done. The command is very simple

GS:LENGTH,PITCH

where LENGTH is a number showing how long you want the note to be and PITCH the frequency of the sound. The numbers must be between 0 and 255. Experiment is all I can say. In a 1980 *Creative Computing* Apple Cart, Chuck Carpenter described what musical note went with what pitch.

Conclusion

This is the last of the Pilot tutorials. I hope that they have given you some indication of what Pilot can do. I have many years of computing experience. However, for quick lesson development, I am really growing to like Pilot. It removes most of the irritating SYNTAX errors that you get when trying to develop a lesson in a hurry. When I find that Pilot can't do all I want, I combine lessons developed in other ways with Pilot lessons.

There are many versions of Pilot which run under Basic or Pascal on various machines (Apple, Pet, and Atari) on the market. Try them and see what you like. Based on my own experience and preferences this is what I would look for.

1. A text editor that can reformat the text without splitting words onto two lines.

2. The text editor should be able to check the form (SYNTAX) of the Pilot commands as you type them in. Most

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errors are simple, and if caught while you are in the editing mode, are very simple to correct.

3. A graphics editor. This should allow a mixture of both text and graphics. Most important is the ability to remove things you don't like. Look for an editor that allows you to remove things half way between the start and end of your program. You should be able to see what you have drawn while you are in the editor.

4. A sound editor. This should allow you to adjust pitch, length and quality of the note. You should have the ability to hear the notes you have made while you are in the editor.

5. Computational speed. For scientific courseware, you might want to generate a thousand random numbers to simulate an experiment. This should not take forever.

6. The ability to type on a printer during a lesson so that a student can keep a copy of something.

The Pilot-to-Basic translator will do this. Try the following

```
B:PRINT CHR$(4);"PR#1"

R: enter what you want to be typed

...

...

B:PRINT CHR$(4);"PR#0"
```

...Powerful instruction, that B: instruction.

7. The ability to call other programs written in Basic or Pilot. This way you can combine good courseware from several sources.

8. The ability to add to the instruction set if you want to. This is very useful if you find you have specialized things you want to do frequently. This basically means good documentation for the person using the courseware and for the hacker...I mean, program modifier. □

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CIRCLE 363 ON READER SERVICE CARD

Improving Readability

Rich Lundeen

Screen interaction is a new art form.
Different strokes for different blokes.

The difference between a professionally designed program and an amateur creation is generally quite obvious to anyone who uses it. Many factors contribute to the differences, but one subtle factor often overlooked by new programmers is the readability of the screen displays and instructions.

You can improve the readability of your programs by remembering to use a few basic principles in the design of your screen displays.

Open Space

First: Always leave plenty of open space. The layout of a screen display is like the layout of a page in a book. It looks much better with margins and blank space around and between paragraphs or elements of the display. Imagine what this article would look like if the first line started at the top of the page and filled every line to the very edge.

When a screen is filled from top to bottom and left to right, it looks very busy and is very difficult to read. A full display implies that nothing on the screen is very important, not to mention the fact that on some screens the edges are so distorted that they can't be read.

On a single display page break the narration into several paragraphs and confine each paragraph to three or four lines of text. Block the edges of each line so that left and right margins are equal. Limiting the number of characters per line will produce a more readable display, but it also forces you to streamline your words and be more concise, and that helps the user to understand your instructions.

Richard Lundeen, 400 Menominee Lane, Naperville, IL 60540.

Use indentation of paragraphs to call attention to specific important points. This is particularly useful for:

lists
menus
numbers
codes
cautions
commands

The use of open space, blocking and indentation will require more screens to be displayed, but from the user point of view it is faster to call up another screen than it is to re-read the same screen many times.

Highlighting is effective, because it ensures that important things are seen even when the user is in a hurry.

Highlighting

Second: Highlight important items. Many user problems can be traced back to a lack of attention to some important step or procedure. Call attention to important items by using the computer's built in highlighting techniques, inverse and flashing. Display key words and paragraphs as inverse characters or use flashing to signal a special precaution.

But be careful: an entire word or paragraph of flashing characters can be very difficult to read. Use flashing on caution words, but use inverse or normal for the explanation. Also remember that inverse numbers and words are easier to read if the spaces before and after are also inverted.

Another way to highlight is to use special characters to separate key words or phrases from other items on the screen.

You can use any of the special symbols to draw lines or boxes around important text.

Other more subtle techniques include the use of CAPITALIZATION, (parentheses) or special symbols before and after ** key words **.

In the previous sentence there are so many things highlighted, and so many different techniques used, that the important items get lost in the jumble. If the user must reread the sentence, then too many good things can be bad. Highlighting is effective *if it's not overdone*, because it ensures that important things are seen even when the user is in a hurry.

Consistency

Third: Be consistent wherever possible. As creatures of habit, people tend to become accustomed to things, and when those things change they become temporarily confused. If users encounter a new format every time they go to a new screen, it will take them a bit longer to read each screen because they must re-adjust their expectations. For instance: if you have been reading screens where the key words are highlighted with capitalization, and suddenly find inverse letters, it takes a while to figure out the significance of the change.

The same concern for consistency should be shown in the layout of the screen and the formatting of paragraphs from screen to screen. Titles are a good way to let users know where they are in the program, but don't change the location and style of the title display each time it is used. Once you have established the location or format for menus, paragraph indentation, input statements or any repeated item, maintain that style and location throughout the program.

The same consistency should be applied to lists, codes and user entries. Text should be left-justified and columns of numbers should be right-justified. Don't ask for

numeric codes one time and alphabetic codes later. Nor should the meaning of codes in different parts of the program be changed.

To minimize user confusion and the errors that can result from misunderstandings, the wording and syntax of instructions must be consistent. The best sequence is always to state the reason first and then the action required. These are examples of that format.

To select option press ...
or
Set parameter by entering...
or
To change value you must...

Another way to give instructions is to use examples in place of narration. Sometimes an example communicates better than words. For instance: Which of the following input requests is most likely to result in correct input from the user?

Enter date.
or
Enter date (month and year)
or
Enter date (eg: APR/80)

How about this pair of requests?

Enter name (last name comma then first name and middle initial and period)
or
Enter name (eg: Doe, John A.)

Remember to use the same terminology throughout your program. Have you ever had trouble deciding if the programmer meant the same thing when you see the words "data base" in one display and then "file" in the next one and "program" after that?

Consistency and conciseness are absolutely essential to professional programs. Frequently, when you forget to tell the user what is required, the only thing that allows him to guess correctly what you wanted is the consistency of past requests.

None of these principles will help your programming efforts. In fact, this just gives you something else to consider and makes more work, but if you do it well, you will be surprised how these techniques are appreciated by the users of your programs. □

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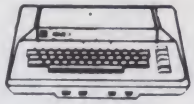

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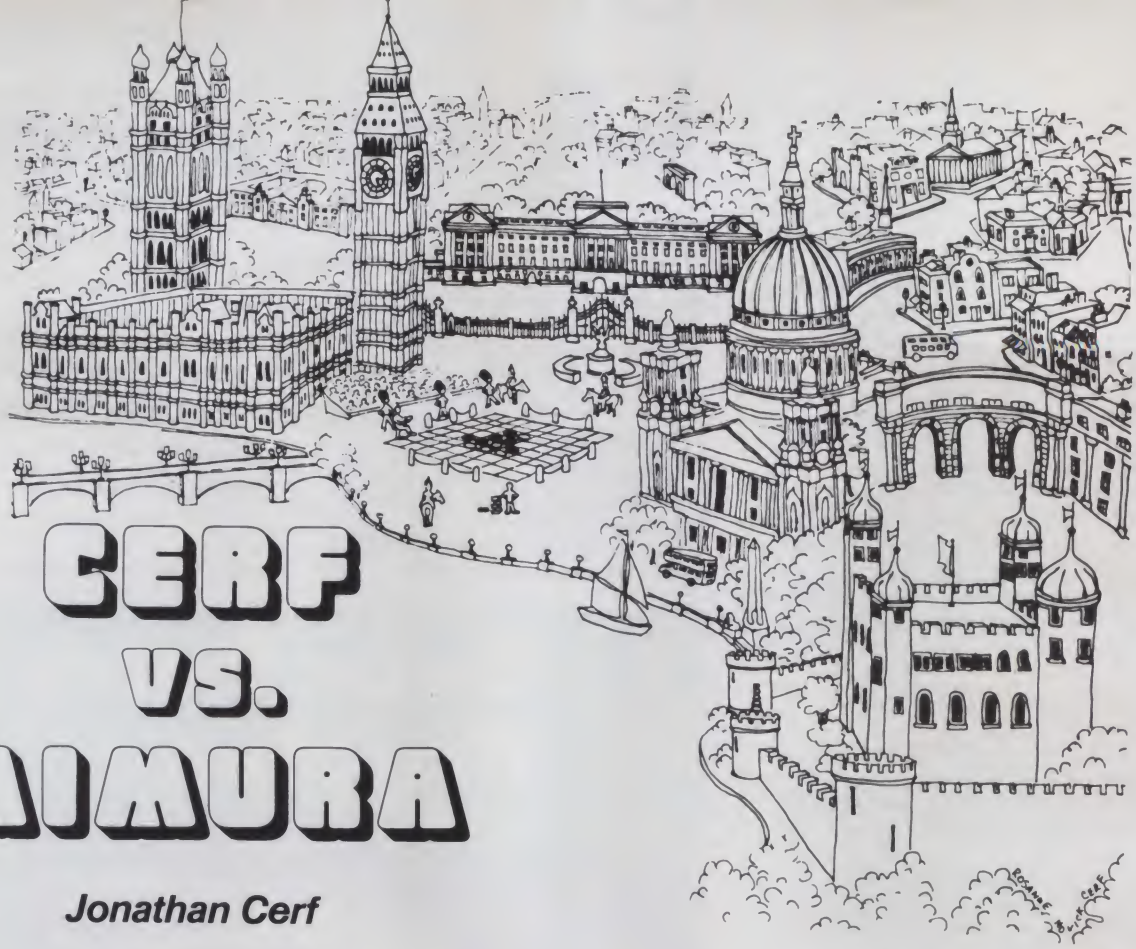

CERF VS. MIMURA

Jonathan Cerf

The game analyzed below was the first of a best of three game set for the 1980 world championship. I was Black. Takuya Mimura, the Japanese champion, was White. (See Diagram 1 for a full game transcription). Like everyone else, I had expected Mimura to win this game. In the four year history of the international competition no Japanese champion had ever lost a game, and my own record against the Japanese was not confidence-inspiring—no wins, six defeats. But I was determined to make things as difficult and unpleasant for Mimura as I possibly could.

Moves 1-10

Mimura (White) chose the perpendicular opening, and the first five moves were very conventional. My moves 3 and 5 were borrowed from Black games of Inoue and Maruoka. At move 6 Mimura departed from published White lines of Inoue and Ohta—they had played 6-c6. Although f3 looks playable at move 7 (Diagram 2), I opted instead for 7-e6. The point of 7-e6 is that it captures central discs at e4 and e5—experience suggests that it is generally unsound to allow your opponent exclusive ownership of the center while your own discs are scattered about the periphery. (7-f3 would not have immediately dealt with the center problem, but would have laid the groundwork for a later correction with a Black move to either c4, c6 or e6.)

Through move 10 the game was identical to a game I had lost to Mimura in the preliminary round. Remarkably, it was also identical to a game I had played against Carol Jacobs a week earlier in the U.S. Nationals. (Carol seems to have a special knack for independently inventing openings preferred by Japanese champions.)

Moves 11-20

During the lunch break following the Preliminaries I replayed my morning loss to Mimura, and I decided that if the opportunity arose I would try something different at move 11. The move I had played against Carol, 11-c4, had been somewhat more successful than my 11-d2 against Mimura, but I now rejected both

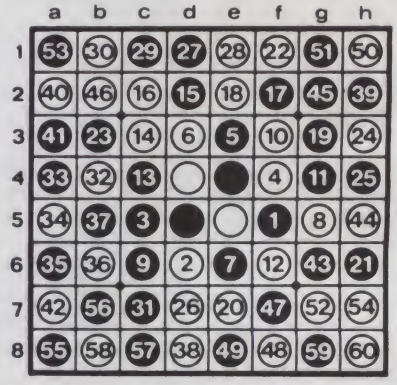

Diagram 1. Cerf (B-44) vs. Mimura(W-20).

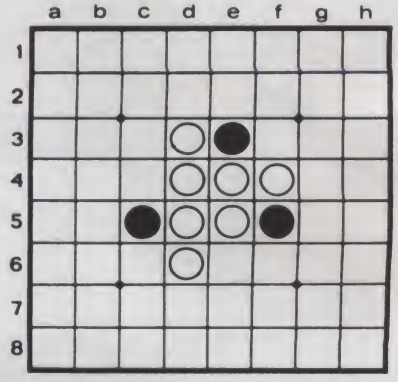

Diagram 2. Black to play. Cerf chose e6.

This article is reprinted from *Othello Quarterly*, the official journal of the United States Othello Association. For information about membership in the USOA (and for a free copy of the *Quarterly*), write: USOA, P.O. Box 342, Falls Church, VA 22046.

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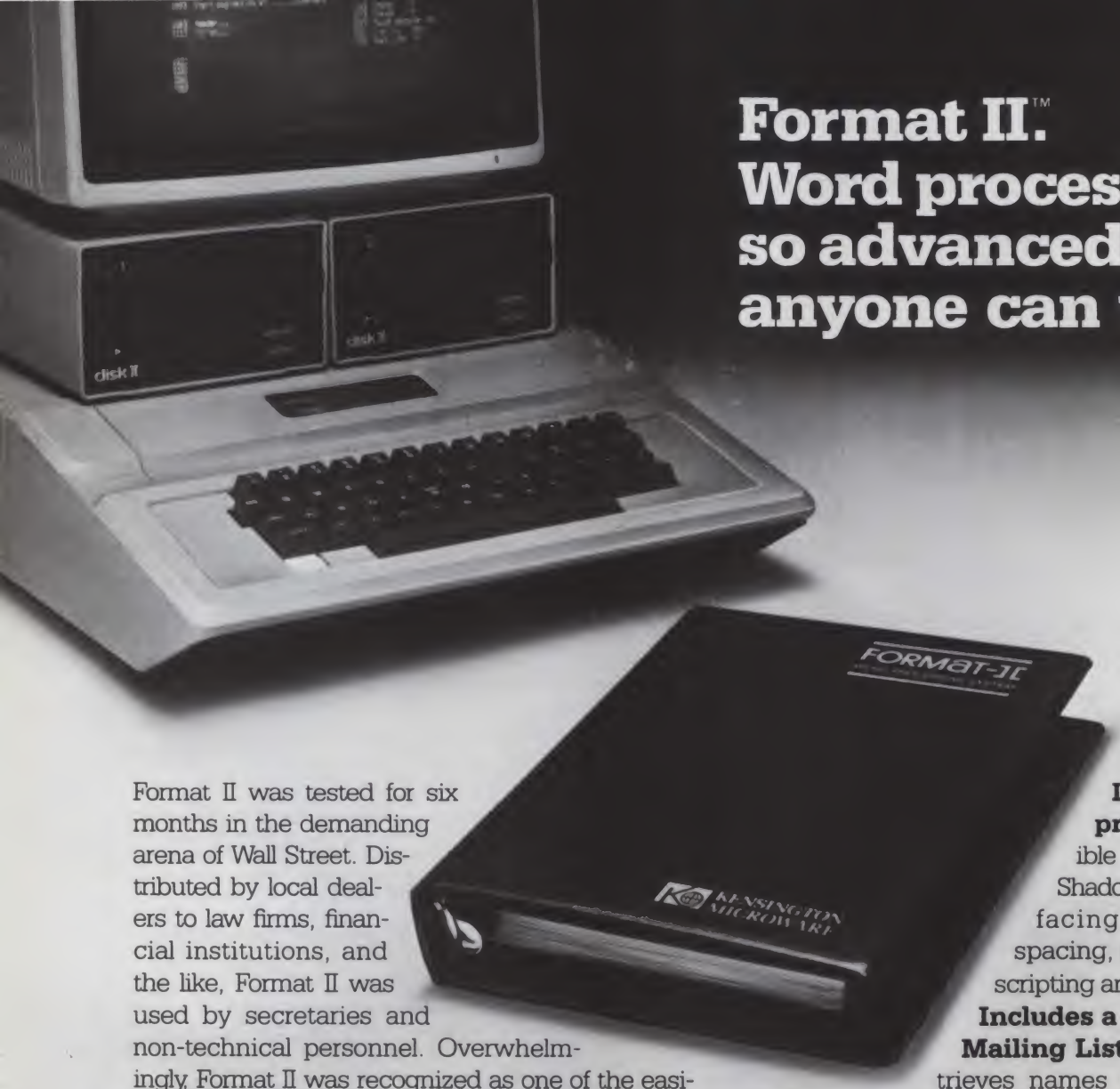

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in favor of 11-g4 (Diagram 3). The g4 move gives Black an uncomfortable disc majority, but it stood up pretty well in the half dozen or so continuations I had time to explore.

Through move 11 Mimura and I had been playing preplanned moves—we had each used less than thirty seconds out of thirty-minute allotments. But now things began to slow down. After Mimura's 12-f6 (Diagram 4), I considered going to g3. What makes the g3 possibility so attractive is that it doesn't alter the overall position very much—a new black disk at g3 would only slightly extend my exposure on the eastern frontier, would make only one new square immediately accessible to White (X-square g2), and would actually eliminate one of White's present options (g3 itself). However, I was concerned that moving now to g3 might interfere with my long-term hopes for row 2. Accordingly, I set out to develop the northern frontier before taking the g3 move. Note that after 13-c4 and 14-c3, 15-d2 did not flip the disc at e3 (if a prior move to g3 had left f4 back, then the d2 move would have flipped e3, making the play prohibitively messy).

My move 17 to f2 may not have been the best choice—b4 or g3 might have been better—but, in any case, Mimura faced a difficult problem at move 18 (Diagram 5). The problem is that e2 looks like a great next move for Black. Like the g3 move discussed above, a Black move to e2 would offer White virtually nothing in the way of new opportunities. As a general rule, when your opponent threatens to make a disconcertingly "quiet" move, there are several things you can do. You may be able to afford to let the move happen if you can respond with a similarly quiet move of your own, but otherwise you should try to stop or discourage the move in one of three ways: deny your opponent access to the threatened square by knocking out the disc he intends to use at the passive end of his flipping line, poison the move by arranging for there to be a solid line of your own discs between the threatened square and some distant opposing piece (this may involve filling in a gap or changing the color of an interposing opponent's piece), or prevent the move by occupying the threatened square yourself. In the case at hand, White cannot deny Black access to e2 because he cannot simultaneously knock out the black disks at c4 and g4. Neither is there any way for White to poison e2 for Black. So Mimura's only chance to prevent the move was to occupy e2 himself, which he did, even though this entailed flipping the frontier disc at d2.

At move 19 I finally took the deferred move to g3, and Mimura responded with 20-e7. Note that in the resulting position (Diagram 6) Mimura is protected against the normal Black continuation 21-d7 since this move would open up a good response for White at g6.

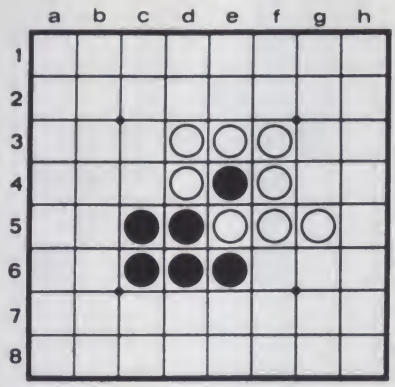


Diagram 3. Black to play at move 11. Cerf chose g4.

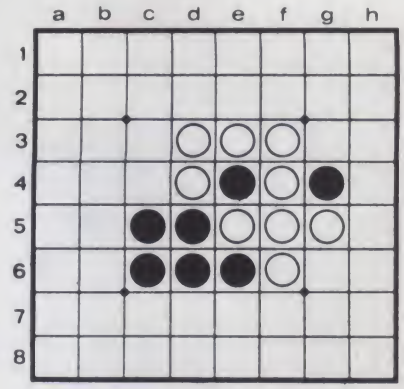


Diagram 4. Position after Mimura's 12-f6.

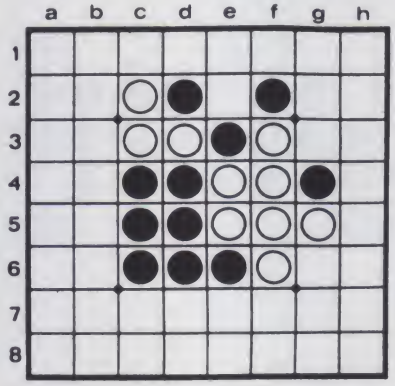


Diagram 5. White to play at move 18.

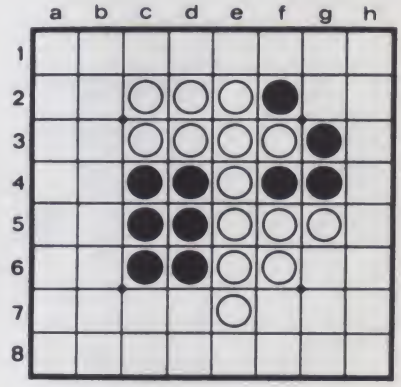
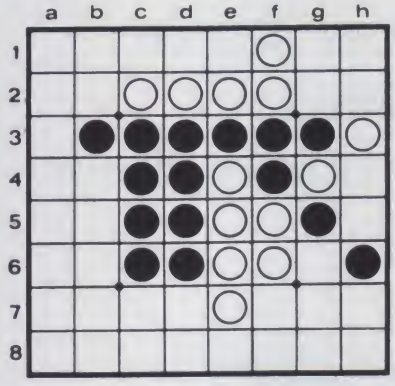


Diagram 6. After White's 20-e6.



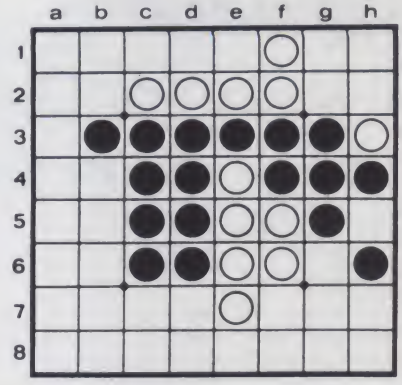


Diagram 7. Before and after Cerf's 25-h4.

Moves 21-30

I was not particularly pleased with any of my options at move 21. I didn't want to do anything that would give Mimura access to g6, I didn't want to flip the disc at e7 because that disc was poisoning Mimura's b4 option, and I didn't want to try b3 because I couldn't find a good answer to Mimura's probable h3 response. I narrowed the choice down to f1 and h6, and then I guessed.

After Mimura's 22-f1 I chose 23-b3 figuring that with a black disc in place at h6 I could now deal satisfactorily with Mimura's possible h3 reply. It's not clear whether Mimura should ever have gone to h3, but, if he was intent on occupying h3, move 24 with row 3 solidly black was the right time to do it—a later White move to h3 would undoubtedly have flipped the disc at g3.

I'm confident my move 25 to h4 was correct (Diagram 7.) I had to be sure of getting the last move on the right-hand side because I couldn't afford to initiate

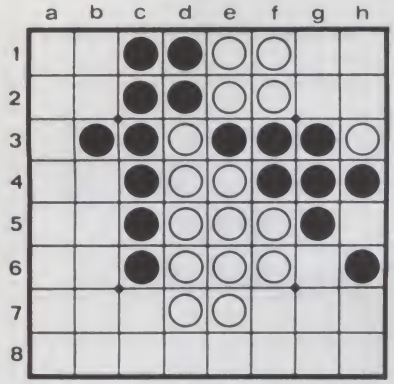


Diagram 8. White to play at move 30.

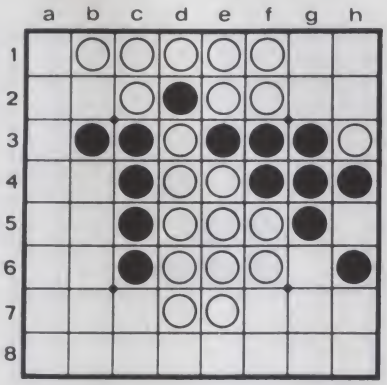
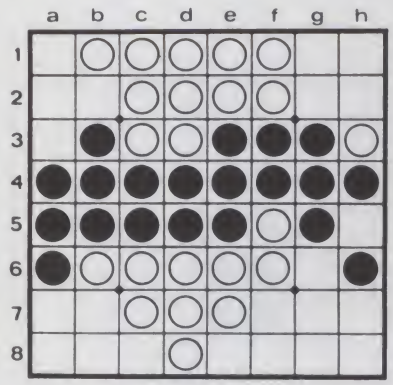


Diagram 9. After Mimura's 30-b1.



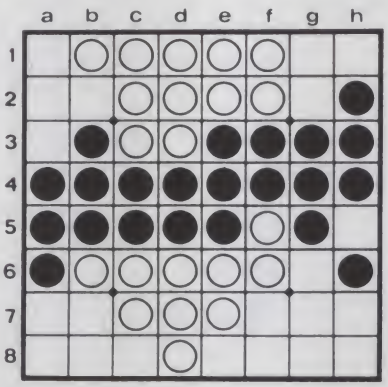


Diagram 10. Before and after Cerf's 39-h2.

play anywhere else—my overall position being extremely precarious. The h4 move seemed preferable to h5 because it soured Mimura's h2 option and also because it gave me access to h2—an advantage that seemed insignificant at the time, but which later turned out to be very important.

Mimura now underwent an experience on the top edge that was very similar to the unpleasantness I had suffered on the right-hand side. Following his 26-d7, I postponed making the natural c7 response in order to capitalize on the now-or-never opportunity to go to d1 without flipping d2 (much as he had gone to h3 without flipping g3). Shortly thereafter, at move 30 (Diagram 8), Mimura faced the choice of allowing me the last move on the top edge or accepting an unbalanced edge with a move to b1. Apparently taking into account the precariousness of his center-board configuration, Mimura seems to have concluded that he couldn't afford to give me the last move on the top. Diagram 9 shows the position after his 30-b1. Note that by moving at any time to h5 Mimura could have induced me to accept an unbalanced edge of my own from h2 to h6. However, my position would have been slightly preferable to his, partly because g6 remained vacant and partly because Mimura could never have used my weak edge to mount an attack on corner h1 without exposing himself to a retaliatory attack on corner a1 via a Black wedge at g1.

Moves 31-60

When I played c7 at move 31, I expected Mimura to try 32-a3, to which I tentatively planned to reply 33-b4. After that, I anticipated 34-a4 leaving me without access to b5 and therefore no obvious response. Consequently, I was relieved when Mimura rejected 32-a3 in favor of 32-b4.

Mimura's moves 34 and 36 look a little peculiar, but they successfully advanced several reasonable objectives. He must have been taking care to keep my g6 option at all times poisoned, and I suspect he may also have been trying to lure me into a move to a7, which would have defused my long-term threat on corner a1 by exposing me to a potential counterattack on corner a8 via a wedge at a2-a3. Furthermore, his 36-b6 gave him access to d8 at move 38, which might have proved significant if I had been forced to follow his lead to the bottom edge.

My position looked terrific after move 38, so at move 39 (Diagram 10), with no good prospects for improving the situation with subtle tinkerings, I went for the throat with a move to h2. The position was still slightly too complex for me to be sure I had the game won, but I was starting to get very excited. I planned to go to g2 if Mimura tried 40-h5 and then of course 43-g1 if he continued with 42-h1. Alterna-

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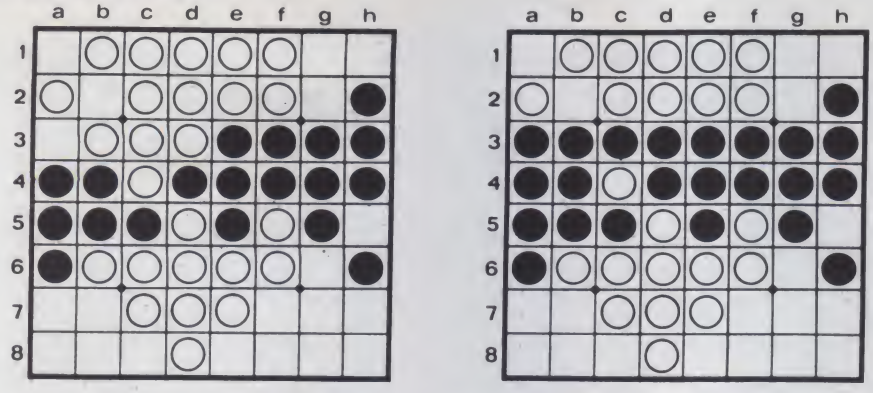


Diagram 11. Before and after Cerf's 41-a3.

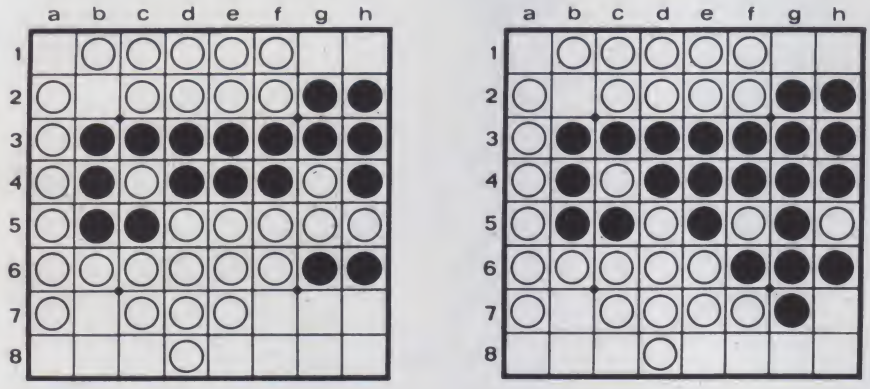


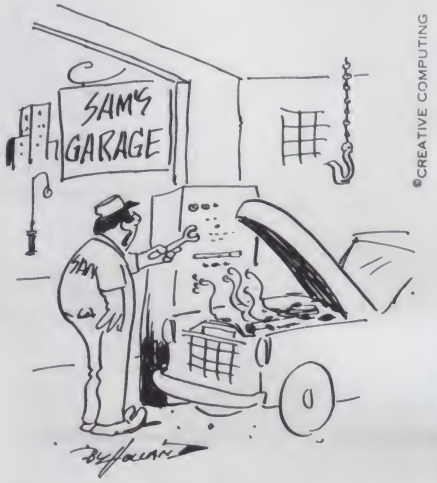
Diagram 12. White to play at move 18.

Diagram 13. Position after hypothetical 47-g7.

tively, if he played 40-a3, I saw nothing wrong with 41-a2. If instead Mimura tried 40-g2, 41-f7 looked like an adequate response, or if he played 40-b2, then 41-a1 seemed acceptable. However, Mimura rejected all of the above options in favor of 40-a2, and because I shared his view that this was his most promising play, I had given this line more thought than the others.

I might have been able to get away with a7 at move 41, but to me a3 looked like a much better play (Diagram 11). 41-a3 completely eliminated the threat of a White wedge at a2-a3 and virtually forced Mimura to respond with a7, thus offering me a potential second corner, a8, in return for the one I was trying to give away, h1. Also, in going to a7 Mimura had to flip the black disc at a6 which had been poisoning my g6 option. As if this weren't enough, a couple of moves later 41-a3 paid me still another dividend. At move 46 (Diagram 12), Mimura was unable to effectively delay and perhaps ultimately escape the h1-a1 corner exchange with a move to f7 because of the threat of a Black g7 response—a threat made possible by move 41 which had simplified the a1-a8 diagonal. Diagram 13 shows the position that would have resulted from 46-f7, 47-g7. From this position White would have had only three options—b2 (giving Black access to corner a1), h1 (offering Black a wedge at g1), and h7 (surrendering corner h8). Therefore, at move 46 Mimura declined to try f7, choosing instead b2 as the best of a bad lot. It was now clear that he could not prevent me from gaining access to corner a1.

And the rest was easy. □



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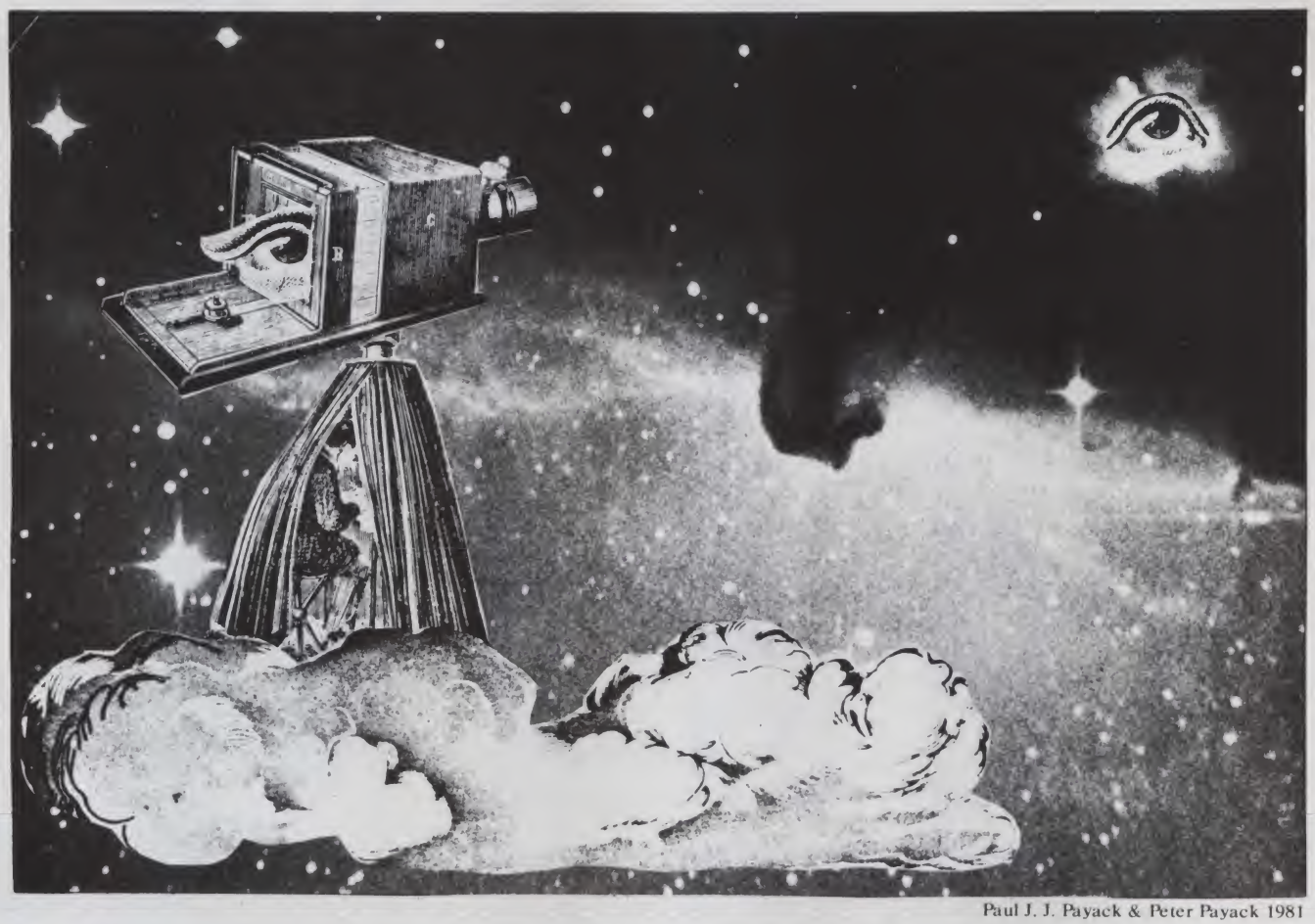

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Picturing Infinity

Peter Payack

Carefully following the instruction manual
that came with my new camera,
I experimented with a whole range of lens settings
as I shot a motley assortment of things,
zooming in for artistic close-ups
and then, for shots of objects more than 25 feet away,
adjusting the setting to maximum focus.

A week later I got the prints back from the developer.
I was surprised the pictures were not only of earthly things
like my cats, a newly planted peach tree,
the neighbor's '57 Chevy, the compost heap
decomposing, the bird feeder, and a close-up
of a caterpillar in mid-slink,
but were also of some heavenly bodies—
the planet Saturn with its silver rings, Polaris,
Halley's Comet (most unspectacular as it was located
somewhere beyond Pluto), the Horse Head Nebula,
a local band of meteors, the Galilean moons of Jupiter,
a white dwarf orbiting a Red Giant
and one blank print which at first I thought didn't come out,
but it was probably a Black Hole!

I was thrilled but somewhat bewildered
by these stunning developments,
until I remembered that, indeed, I had set
the lens to maximum—"infinity"!

Then disappointment set in.
As it was, the farthest object that I got a print of
was the Andromeda Galaxy
which at a distance of 2 million light years
isn't exactly infinity,
but after all,
my camera is only a pocket instamatic. □

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MEM-99510K *Kit with manual* **$154.95**
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CPC-30200A *A & T* **$399.95**

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CPU-30300A *A & T with manual* **$274.95**

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CPU-30400A *A & T with PROM* **$289.95**

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Double density disk controller for any combination of 5¼" and 8" single or double sided, analog phase-locked loop data separator, vectored interrupts, CP/M 2.2 & Oasis compatible, control/diagnostic software PROM included.

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IOD-1200A *A & T w/hdwr & sftwr man* **$325.95**
SFC-59002001F *CP/M 2.2 with Double D* **$99.95**

S-100 Memory Boards

256K RAMDISK - SD Systems

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MEM-12810A *A & T* **$1609.95**
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MEM-64566A *64K A & T* **$424.95**

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MEM-48632A *48K A & T* **$384.95**
MEM-64633A *64K A & T* **$399.95**

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MEM-32731K *32K kit* **$199.95**
MEM-64733K *64K kit* **$249.95**
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Multi-user I/O multiplexer & interrupt controller with on-board 8085A-2 CPU & 4K or 16K of RAM.

IOI-1875A *4K MPX A & T* **$444.95**
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IOI-1010A *A & T with manual* **$249.95**

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Six asynchronous RS-232C serial I/O ports with programmable baud rates.

IOI-1040A *A & T with manual* **$529.95**

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IOI-1060A *A & T with manual* ***$319.95***

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Two RS-232C serial I/O ports plus two 8 bit parallel I/O ports.

IOI-1080A *A & T with manual* **$349.95**

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CIRCLE 210 ON READER SERVICE CARD

Parallel Processing For Your Computer?

Edward E. Brent, Jr.

Parallel processing! True parallel processing, according to the *Encyclopedia Of Computer Science*, is the operation of two or more processes at the same time (Ralston and Meek, 1976). How can a microcomputer with a single microprocessor have parallel processing in which two or more processes are being performed at the same time? Like many other microcomputer users, I at first labored under the misconception that my computer had only one processor and hence could not do two things at once. But I was wrong.

Every microcomputer on the market today operates interactively and hence requires two processors to operate: the microprocessor which drives the computer, and an older, somewhat more archaic, often unreliable, but remarkably efficient processor: *the user*.

Admittedly, to speak of parallel processing between the computer and the user is stretching a term which is usually used to refer to processing within the machine. However, if you can keep an open mind and consider the insights this concept of parallel processing might have, perhaps you, too, will find ways it can be useful in your programming.

The need for parallel processing between the computer and the user is made clear by the many programs, including even expensive ones costing hundreds of dollars, which fail to take advantage of parallel processing. Most programs available today have not been written to take advantage of these two processors, probably because most programmers continue to believe that microcomputers have only a single processor. As a result most programs employ *serial processing* in which alternately the computer sits idly by while the user responds to a prompt to enter data, then the user sits idly by while the computer performs what may be lengthy computation or data transfer processes.

Serial processing is used in virtually every kind of programming. It occurs, for example, in many database management programs which have the computer do little, or more likely nothing, while the user is entering data for a record, then force the user to twiddle his thumbs or contemplate his navel or use other more creative techniques to fight off boredom while the program grinds through lengthy search or I/O processes.

Similarly, the spreadsheet business programs such as *Visicalc* do little or no processing while the user is entering data, and then may require the user to wait for minutes at a time while the program performs lengthy computations or writes data to a disk.

So far I have concentrated on those tasks which push the computer to its limit while the user sits impatiently. But to be fair we must admit that we users can be pretty boring too. There are many times when the computer waits patiently for a response from the user, who may be trying to figure out what that variable could be, searching for the correct value in a stack of paper, or off in the kitchen refilling a coffee cup. I can't speak for all users, but most of the time my Apple waits for me at least as often and as long as I wait for it.

For many of these programs, a little more attention to timing might coordinate these operations more effectively so neither the computer nor the user need sit idle any longer than necessary. In addition to reducing the waiting time for both the user and the machine, parallel processing would reduce the overall execution time for programs, permitting the same task to be performed in less time.

In this article I discuss a few fundamental principles which guide attempts to achieve parallel processing. Each of these is illustrated with simple procedures which may be used to take advantage of parallel processing. Then I illustrate the use of these procedures for a few commonly encountered programming tasks which often try the user's patience and bring out the worst in the computer as well. These tasks include user input, disk or printer I/O, and lengthy iterative computations.

After the specific examples are discussed, I discuss several advantages of these procedures, some of their potential disadvantages and limitations, and some possible directions for the future. Let's begin by describing a program which approaches all these tasks using a traditional serial processing program design.

Serial Processing Programs: An Example

Listing 1 is a simple amortization program written in Applesoft Basic for an Apple II+ computer. This program has steps commonly encountered in a wide range of programs. First (lines 100-170), the program prompts the user for information describing himself and a loan to consider. Second (lines 200-360), it performs computations to determine the amortization schedule for the term of that loan. Finally, it saves the resulting information in a file on disk (lines 500-545) and prints a summary of the results for the user on a printer (700-910).

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This program illustrates problems common to many programs which may benefit from parallel processing; problems such as prompting the user for information, performing iterative calculations, saving data to a disk, and printing out a report.

Again, like most programs, this program is designed for serial processing. First the necessary data are obtained; the necessary computations are performed; and finally, the results are saved to disk and printed out. However, if we examine the amount of time spent on each task we see that the first part of the program (the data input) involves a time when the primary task of the computer is to emulate a maid in waiting while the user decides what to enter. Likewise, the last parts of the program are likely to have the user waiting in nervous anticipation while the computer grinds out the calculations, watching helplessly as the disk drive whirrs, or entertaining himself by trying to read the printout as the printer is printing. Thus, during the first part of the program, a machine costing thousands of dollars sits nearly idle, while during the last part, a user who may not tolerate boredom and inefficiency in other settings may be having second thoughts about the joys of microcomputing.

Parallel Processing Program Design

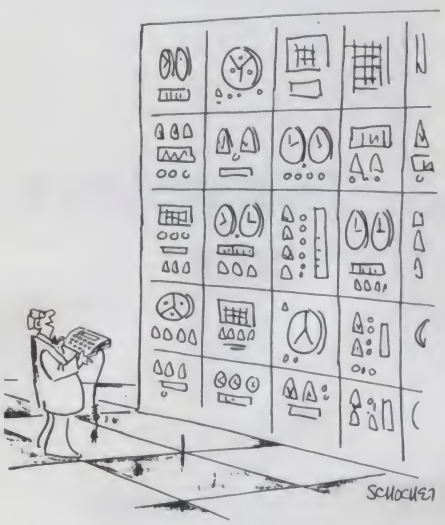
With a few simple changes, the serially organized program in Listing 1 can be redesigned to permit parallel processing by computer and user. There are a few simple principles which may guide attempts to achieve parallel processing in microcomputers.

First Principle: The first, and central principle of parallel processing is to *maximize simultaneous processing*. There are two procedures which maximize simultaneously processing for microcomputers, one for the user and one for the computer.

One way to enable the user to "process" while the computer is at work is to have the computer prompt the user as soon as possible after it has determined the appropriate prompt, then permit the user to consider the alternatives while the program performs whatever other tasks may be done at that time.

Listing 1.

```
10  REM  ************************
11  REM  * AMORTIZATION         *
12  REM  * SCHEDULE PROGRAM     *
13  REM  * USING TRADITIONAL    *
14  REM  * SERIAL PROCESSING    *
15  REM  * DESIGN               *
16  REM  ************************
40  DIM BALANCE(480),I1(480),PRINCIPAL(480),TI(480)
50 NN = 1
100  REM  ***********************
110  REM  INPUT DATA SUBROUTINE
120  REM  ***********************
130  INPUT "YOUR NAME: ";NAME$
140  PRINT "SOURCE OF LOAN ";NN;  INPUT ": ",SOURCE$
150  INPUT "ANNUAL INTEREST RATE: ";IN
160  INPUT "AMOUNT OF LOAN: ",AMOUNT
170  INPUT "TERM OF LOAN IN YEARS: ";YEARS
200  REM  ************************
210  REM  CALCULATION SUBROUTINE
220  REM  ************************
230 I = IN / 12
240 MO = YEARS * 12
250 A = AMOUNT * I * (I + 1) ^ MO / (((I + 1) ^ MO) - 1)
260  DEF  FN MR(X) = ( INT (100 * (X +  .005))) / 100
270 A =  FN MR(A)
280 NL = 0:BALANCE(0) = AMOUNT:TIN(0) = 0
290  FOR PMT = 1 TO MO
300 I1(PMT) =  FN MR(I * BALANCE(PMT - 1))
310 PRINCIPAL(PMT) =  FN MR(A - I1(PMT))
320  IF PMT <  > MO THEN  GOTO 340
330 PRINCIPAL(PMT) = BALANCE(PMT)
340 BALANCE(PMT) =  FN MR(BALANCE(PMT - 1) - PRINCIPAL(PMT))
350 TIN(PMT) =  FN MR(TIN(PMT - 1) + I1(PMT))
360  NEXT PMT
500  REM  ************************
501  REM  SAVE TO DISK SUBROUTINE
502  REM  ************************
503  INPUT "WOULD YOU LIKE TO SAVE INFORMATION
       ABOUT THIS LOAN ON DISK? ";IN$
504  IF IN$ <  > "Y" GOTO 700
505 D$ =  CHR$ (4)
510  PRINT D$;"OPEN DATA"
512  PRINT D$;"APPEND DATA"
515  PRINT D$;"WRITE DATA"
520  PRINT NAME$
525  PRINT SOURCE$
530  PRINT IN
535  PRINT AMOUNT
540  PRINT YEARS
545  PRINT D$;"CLOSE DATA"
700  REM  ********************
710  REM  PRINTING SUBROUTINE
720  REM  ********************
730  INPUT "DO YOU WANT TO PRINT OUT AN AMORTIZATIONSCHEDULE? ";IN$
740  IF IN$ <  > "Y" GOTO 1010
750  INPUT "WHICH SLOT IS YOUR PRINTER IN? ";S%
760  PRINT "TURN YOUR PRINTER ON PLEASE"
770 D$ =  CHR$ (4):  PRINT D$,"PR#",S%
780  PRINT "MONTHLY PAYMENT = ";A
790  PRINT "PAYMENT", SPC( 5),"PRINCIPAL"; SPC( 5);"INTEREST"; SPC( 5),
      "BALANCE"; SPC( 5),"INTEREST TO DATE"
800  FOR PMT = 1 TO MO
810 SS$ = "                "
820 S$(1) =  STR$ (PMT) + SS$
830 S$(2) =  STR$ (PRINCIPAL(PMT)) + SS$
840 S$(3) =  STR$ (I1(PMT)) + SS$
850 S$(4) =  STR$ (BALANCE(PMT)) + SS$
860 S$(5) =  STR$ (TI(PMT)) + SS$
870  FOR MM = 1 TO 5
880 S$(MM) =  LEFT$ (S$(MM),10)
890  NEXT MM
900  PRINT S$(1); TAB( 5);S$(2); TAB( 5);S$(3); TAB( 5);S$(4); TAB( 5);S$(5)
910  NEXT PMT
1000  PRINT D$;"PR#0"
1010  PRINT
1020  INPUT "DO YOU WANT TO CONSIDER ANOTHER LOAN? ";IN$
1030  IF IN$ = "Y" THEN NN = NN + 1:  GOTO 140
1040  END
```



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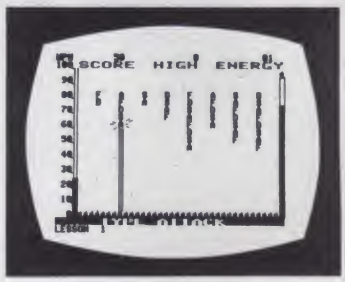

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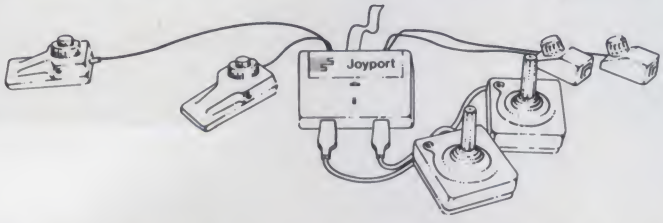

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Similarly, the computer can be permitted to "process" while the user is thinking about the next response by programming it to seek out activities which can be performed while awaiting the next response.

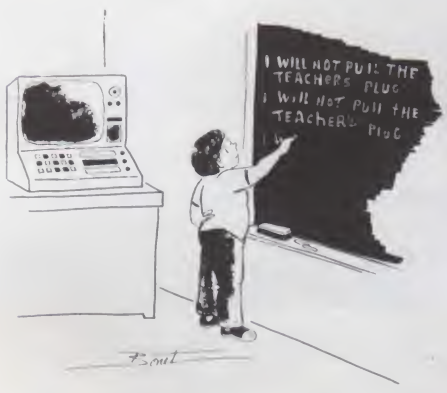
Obviously, these two procedures are related. Hence, parallel processing can be maximized by identifying those segments of the program which take considerable computer time and scheduling them to occur at the same time as other segments requiring considerable user time.

When the user is likely to be slow in responding the computer should take advantage of the situation to perform its own time-consuming tasks. And when the user is likely to be quick in responding or have little or nothing to do, the computer should minimize its own response time by postponing time-consuming tasks.

These procedures are illustrated for the example of the amortization program by a recognized version of this program presented in Listing 2. This version of the program reschedules data input by the user to correspond more closely with those times when the computer is performing time-consuming tasks. During each phase of the program in which the computer is likely to require the longest time to respond, the user can be using that same time to formulate a response to the prompt on the screen.

This program reschedules the data input by the user to ask first for the information required for the computations. Then, while the computer is performing the computations, the program asks the user for additional information. This technique is particularly effective if the second group of user prompts occurring while the program is processing data generally requires the user to take a fair amount of time before responding.

While this version of the input routine should be faster than the serial version



Listing 2.

```
10  REM  ************************
11  REM  * AMORTIZATION         *
12  REM  * SCHEDULE PROGRAM     *
13  REM  * USING ELEMENTARY     *
14  REM  * PARALLEL PROCESSING  *
15  REM  * DESIGN               *
16  REM  ************************
40  DIM BALANCE(480),I1(480),PRINCIPAL(480),TI(480)
50 NN = 1:KK = 0
100  REM  ***********************
110  REM  INPUT DATA SUBROUTINE
120  REM  ***********************
130  INPUT "YOUR NAME: ";NAME$
150  INPUT "ANNUAL INTEREST RATE: ";IN
160  INPUT "AMOUNT OF LOAN: ";AMOUNT
170  INPUT "TERM OF LOAN IN YEARS: ";YEARS
180  PRINT "SOURCE OF LOAN ";NN;": ";
200  REM  ***********************
210  REM  CALCULATION SUBROUTINE
220  REM  ***********************
230 I = IN / .12
240 MO = YEARS * 12
250 A = AMOUNT * I * (I + 1) ^ MO / (((I + 1) ^ MO) - 1)
260 DEF  FN MR(X) = ( INT (100 * (X + .005))) / 100
270 A =  FN MR(A)
280 NL = 0:BALANCE(0) = AMOUNT:TIN(0) = 0
290  FOR PMT = 1 TO MO
300 I1(PMT) =  FN MR(I * BALANCE(PMT - 1))
310 PRINCIPAL(PMT) =  FN MR(A - I1(PMT))
320  IF PMT <  > MO THEN  GOTO 340
330 PRINCIPAL(PMT) = BALANCE(PMT)
340 BALANCE(PMT) =  FN MR(BALANCE(PMT - 1) - PRINCIPAL(PMT))
350 TIN(PMT) =  FN MR(TIN(PMT - 1) + I1(PMT))
360  NEXT PMT
370  INPUT SOURCE$
500  REM  ***********************
501  REM  SAVE TO DISK SUBROUTINE
502  REM  ***********************
503  INPUT "WOULD YOU LIKE TO SAVE INFORMATION
       ABOUT THIS LOAN ON DISK? ";I N$
504  PRINT "DO YOU WANT TO PRINT OUT AN AMORTIZATIONSCHEDULE? "
505  IF IN$ <  > "Y" GOTO 700
506 D$ =  CHR$ (4)
510  PRINT D$;"OPEN DATA"
512  PRINT D$;"APPEND DATA"
515  PRINT D$;"WRITE DATA"
520  PRINT NAME$
525  PRINT SOURCE$
530  PRINT IN
535  PRINT AMOUNT
540  PRINT YEARS
545  PRINT D$;"CLOSE DATA"
700  REM  ********************
710  REM  PRINTING SUBROUTINE
720  REM  ********************
730  INPUT IN$
740  IF IN$ <  > "Y" THEN KK = 1: GOTO 1010
750  INPUT "WHICH SLOT IS YOUR PRINTER IN? ";S%
760  PRINT "TURN YOUR PRINTER ON PLEASE"
761  PRINT
762  PRINT "DO YOU WANT TO CONSIDER ANOTHER LOAN? "
770 D$ =  CHR$ (4): PRINT D$;"PR#";S%
780  PRINT "MONTHLY PAYMENT = ";A
790  PRINT "PAYMENT"; SPC( 5);"PRINCIPAL"; SPC( 5);"INTEREST"; SPC( 5);
       "BALANCE" , SPC( 5),"INTEREST TO DATE"
800  FOR PMT = 1 TO MO
810 SS$ = "                "
820 S$(1) =  STR$ (PMT) + SS$
830 S$(2) =  STR$ (PRINCIPAL(PMT)) + SS$
840 S$(3) =  STR$ (I1(PMT)) + SS$
850 S$(4) =  STR$ (BALANCE(PMT)) + SS$
860 S$(5) =  STR$ (TI(PMT)) + SS$
870  FOR MM = 1 TO 5
880 S$(MM) =  LEFT$ (S$(MM),10)
890  NEXT MM
900  PRINT S$(1), TAB( 5);S$(2), TAB( 5),S$(3), TAB( 5),S$(4), TAB( 5),S$(5)
910  NEXT PMT
1000  PRINT D$;"PR#0"
1010  PRINT
1011  IF KK = 1 THEN  PRINT "DO YOU WANT TO CONSIDER ANOTHER LOAN? "
1015 KK = 0
1020  INPUT IN$
1030  IF IN$ = "Y" THEN NN = NN + 1: GOTO 150
1040  END
```

DYNACOMP

Quality software for:*

APPLE II Plus	ALTAIR****
OSBORNE-1	NEC PC-8000
NORTH STAR***	TRS-80 (Level II)**
ATARI	SUPERBRAIN*****
PET/CBM	CP/M Disks/Diskettes

(See Availability box MBASIC/CBASIC)

CARD GAMES

NEW

BRIDGE MASTER (Available for all computers) Price: $21.95 Diskette

If you liked DYNACOMP'S BRIDGE 2.0, you will absolutely love BRIDGE MASTER. BRIDGE MASTER is a comprehensive bridge program designed to provide hours of challenging competition. Bidding features include the Blackwood convention, Stayman convention, pre-emptive openings, and recognition of demand bids and jump-shift responses. After playing a specific hand, you may replay the same hand, with the option of switching cards with your computer opponents. This feature allows you to compare your bidding and playing skills to BRIDGE MASTER. Bonuses for game contracts and slams are awarded as in duplicate bridge. Doubled contracts are scored based upon a computer assigned vulnerability. A score card is displayed at the conclusion of each hand. The score card displays a summary of total hands played, total points scored, number of contracts made and set, and % bids made. BRIDGE MASTER is clearly the best computer bridge program available.

DYNACOMP'S previous BRIDGE 2.0 customers may upgrade to BRIDGE MASTER for a nominal charge of $5.00 plus postage and handling (see ordering information box). Original cassette/diskette must be returned.

BACCARAT (Atari only) Price: $18.95 Cassette/$22.95 Diskette

This is the European card game which is the favorite of the Monte Carlo jet set. Imagine yourself at the gaming table with 007 to your left and Goldfinger to your right. Learn and play BACCARAT at your leisure on the Atari. Contains full high resolution color graphics and matching sound. Runs in 16K. Requires one joystick.

GIN RUMMY (Apple diskette only) Price: $22.95 Diskette

This is the best micro computer implementation of GIN RUMMY existing. The computer plays exceptionally well, and the HIRES graphics are superb. What else can be said?

POKER PARTY (Available for all computers) Price: $19.95 Cassette/$23.95 Diskette

POKER PARTY is a draw poker simulation based on the book, POKER, by Oswald Jacoby. This is the most comprehensive version available for micro computers. The party consists of yourself and six other (computer) players. Each of these players (you will get to know them) has a different personality in the form of a varying propensity to bluff or fold under pressure. Practice with POKER PARTY before going to that expensive game tonight! Apple cassette and diskette versions require a 32K (or larger) Apple II.

GO FISH (Available for all computers) Price: $14.95 Cassette/$18.95 Diskette

GO FISH is a classic children's card game. The opponent is a friendly computer with user inputs that are simple enough for small children to easily master. The Apple and Atari versions employ high resolution graphics for the display of hands. A must for children! Runs in 16K.

NEW

BLACKJACK COACH (32K TRS-80 only) Price: $29.95 Cassette/$33.95 Diskette

BLACKJACK COACH teaches and evaluates professional playing methods. This program will coach you using the Basic and the Complex Card Counting Methods. The BLACKJACK COACH can be used in automatic, unattended play to test the playing and betting strategies you select. Extensive summary reports pinpoint the strengths and weaknesses of various methods of play. All the standard player choices are included: Insurance, splitting pairs, double downs and surrender (optional). A line printer may be used to collect data. If you risk money at the tables, increase your skills with the BLACKJACK COACH!

THOUGHT PROVOKERS

MANAGEMENT SIMULATOR (Available for all computers) Price: $25.95 Cassette/$29.95 Diskette

This program is both an excellent teaching tool as well as a stimulating intellectual game. Based upon similar games played at graduate business schools, each player or team controls a company which manufacturers three products. Each player attempts to outperform his competitors by setting selling prices, production volumes, marketing and design expenditures etc. The most successful firm is the one with the highest stock price when the simulation ends.

FLIGHT SIMULATOR (Available for all computers) Price: $19.95/Cassette/$23.95 Diskette

A realistic and extensive mathematical simulation of take-off, flight and landing. The program utilizes aerodynamic equations and the characteristics of a real airfoil. You can practice instrument approaches and navigation using radials and compass headings. The more advanced flyer can also perform loops, half-rolls and similar aerobatic maneuvers. Although this program does not employ graphics, it is exciting and very addictive. See the software review in COMPUTRONICS. Runs in 16K Atari.

VALDEZ (Available for all computers) Price: $17.95 Cassette/$21.95 Diskette

VALDEZ is a computer simulation of supertanker navigation in the Prince William Sound/Valdez Narrows region of Alaska. Included in this simulation is a realistic and extensive 256 x 256 element map, portions of which may be viewed using the ship's alphanumeric radar display. The motion of the ship itself is accurately modelled mathematically. The simulation also contains a model for the tidal patterns in the region, as well as other traffic (outgoing tankers and drifting icebergs). Chart your course from the Gulf of Alaska to Valdez Harbor! See the software reviews in 80 Software Critique, Personal Computing and Creative Computing.

BACKGAMMON 2.0 (Available for all computers) Price: $19.95 Cassette/$23.95 Diskette

This program tests your backgammon skills and will also improve your game. A human can compete against a computer or against another human. The computer can even play against itself. Either the human or the computer can double or generate dice rolls. Board positions can be created or saved for replay. BACKGAMMON 2.0 plays in accordance with the official rules of backgammon and is sure to provide many fascinating sessions of backgammon play.

NEW

FROG MASTER (Atari only) Price: $17.95 Cassette/$21.95 Diskette

The Atari APEX first prize winner. FROG MASTER contains exciting arcade features in addition to being a highly educational program. It is a fast-moving high-concentration game for 1-4 players. You score by making touchdowns on the opponents' goal line – if his goalie doesn't get there first. But your players (tadpoles and frogs) must be trained. This is accomplished by giving them a reward at just the right moment when they do something right. This takes precise timing and judgement. Your critters must penetrate barriers and avoid evil line backs if they are to score. Many will fall by the wayside, but some will get through. As they learn you can look inside their heads to see how they think. As you reward them, they reward you (the "thought processes" simulated demonstrate the basic type of animal learning - operant conditioning - widely studied in high school and college courses). As you teach them they teach you how learning takes place! Great graphics! Runs in 16K. Requires two joysticks.

FOREST FIRE! (Atari only) Price: $14.95 Cassette/$18.95 Diskette

Using excellent graphics and sound effects, this simulation puts you in the middle of a forest fire. Your job is to direct operations to put out the fire while compensating for changes in wind, weather and terrain. Not protecting valuable structures can result in startling penalities. Life-like variables are provided to make FOREST FIRE! very suspenseful and challenging. No two games have the same setting and there are 3 levels of difficulty.

CRANSTON MANOR ADVENTURE (North Star, SuperBrain and CP/M only) Price: $19.95 Diskette

At last! A comprehensive Adventure game for North Star and CP/M systems. CRANSTON MANOR ADVENTURE takes you into mysterious CRANSTON MANOR where you attempt to gather fabulous treasures. Lurking in the manor are wild animals and robots who will not give up the treasures without a fight. The number of rooms is greater and the associated descriptions are much more elaborate than the current popular series of Adventure programs, making this game the top in its class. Play can be stopped at any time and the status stored on diskette.

SPACE EVACUATION† (Available for all computers) Price: $15.95 Cassette/$19.95 Diskette

Can you colonize the galaxy and evacuate the Earth before the sun explodes? Your computer becomes the ship's computer as you explore the universe to relocate millions of people. This simulation is particularly interesting as it combines many of the exciting elements of classic space games with the mystery challenge of ADVENTURE.

MONARCH (Atari only) Price: $14.95 Cassette/$18.95 Diskette

MONARCH is a fascinating economic simulation requiring you to survive an 8-year term as your nation's leader. You determine the amount of acreage devoted to industrial and agricultural use, how much food to distribute to the populace and how much should be spent on pollution control. You will find that all decisions involve a compromise and that it is not easy to make everyone happy. Runs in 16K Atari.

NEW

RUBIK'S CUBE SOLVER (Available for all computers) Price: $14.95 Cassette/$18.95 Diskette/$21.45 Disk

Solving the Rubik's cube puzzle is an exercise in algorithmic logic, and is a "natural" for computer calculation. The RUBIK'S CUBE SOLVER permits you to input the starting state of the 24 facing elements of the cube. It then solves the problem one step at a time, with each step shown as a unfolded view of the cube. Can you solve the cube in fewer steps. In any case, it sure beats disassembling the cube or peeling off and replacing the colors! Requires 16K.

AVAILABILITY

DYNACOMP software is supplied with complete documentation containing clear explanations and examples. Unless otherwise specified, all programs will run within 16K program memory space (ATARI requires 24K). Except where noted, programs are available on ATARI, PET, TRS-80 (Level II), NEC and Apple II (Applesoft) cassette and diskette as well as North Star single density (double density compatible) diskette. Additionally, most programs can be obtained on standard (IBM 3740 single density/double density compatible format) 8" CP/M floppy disks for systems running under MBASIC or CBASIC (for example: Altos, Xerox 820, Heath/Zenith and many others). 5¼" CP/M diskettes are available for the North Star, SuperBrain and Osborne computer systems.

*ATARI, PET/CBM, NORTH STAR/CP/M, IBM, OSBORNE, SUPERBRAIN, NEC PC-8000 and XEROX are registered tradenames and/or trademarks.

**Except where noted, all TRS-80 Model I software is available on cassette (only) for the TRS-80 Model III. Exceptions: VALDEZ, CRIBBAGE, GRAFIX, CHESSMASTER. TRS-80 diskettes are not supplied with either DOS or BASIC.

***For most North Star disk-based systems.

****For Altair systems having Microsoft BASIC.

*****For SUPERBRAIN systems running under MBASIC or CBASIC (state which).

DYNACOMP OFFERS THE FOLLOWING

- Widest variety
- Guaranteed quality
- Fastest delivery
- Friendly service
- Free catalog*
- Toll free order phone

*$2.00 U.S. funds for foreign mailing

AND MORE...

NEW

STARBASE 3.2 (Available for all computers) Price: $13.95 Cassette/$17.95 Diskette

This is the classic space simulation, but with several new features. For example, the Croylins now shoot at the Invincible without warning while also attacking starbases in other quadrants. The Croylins also attack with both light and heavy cruisers and move when shot at! The situation is hectic when the Invincible is besieged by three heavy cruisers and a starbase. S.O.S. is received! The Croylins get even! See the software reviews in A.N.A.L.O.G., 80 Software Critique and Game Merchandising.

LIL' MEN FROM MARS (Atari only) Price: $19.95 Cassette/$23.95 Diskette

Defend yourself! The little men from Mars are out to get you if you don't get them first. This is a hilarious high resolution animated graphics (arcade) game which exercises much of the Atari's power. Requires one joystick.

ALVIN (Atari only) Price: $17.95 Cassette/$21.95 Diskette

ALVIN is a great arcade game. You are commanding a highly maneuverable ship seeking to destroy several enemy cities. You are attempting to bomb these cities while at the same time trying to avoid their defensive fire (MISSILE COMMAND" in reverse?). Also, your radar has been damaged so that you can only see downwards. This would normally not be much of a problem except that you also have to contend with high-flying enemy aircraft. As long as you are above these aircraft you have the advantage and are safe. However, high level bombing takes considerable skill. Therefore to achieve your goal the best strategy is to swoop down for a bombing run while the enemy craft is out of range, and quickly retreat to the skies. A fun game. Requires 16K.

ESCAPE FROM VOLANTIUM (Atari only) Price: $15.95 Cassette/$19.95 Diskette

Bring the action and excitement of an arcade into your home with ESCAPE FROM VOLANTIUM! To escape you must maneuver your space ship around obstacles and laser blast the guardian (without being eaten). If he is killed with a direct shot (not just a leg lopped off), a door opens to the outside. However, the door does not stay open indefinitely. If you fail to escape in time, the door closes and a new guardian appears. Sometimes you can smash through the door by repeatedly chipping away at it. Other times it is impervious. At the higher levels nl play more obstacles and guardians appear, adding to the excitement. Uses high resolution graphics and sound. Runs in 16K.

ALPHA FIGHTER (Atari only) Price: $13.95 Cassette/$17.95 Diskette

Two excellent graphics and action programs in one! ALPHA FIGHTER requires you to destroy the alien starships passing through your sector of the galaxy. ALPHA BASE is in the path of an alien UFO invasion; let live UFO's get by and the game ends. Both games require the joystick and get progressively more difficult the higher you score! ALPHA FIGHTER will run on 16K systems.

THE RINGS OF THE EMPIRE (Atari only) Price: $14.95 Cassette/$18.95 Diskette

The empire has developed a new battle station protected by rotating rings of energy. Each time you blast through the rings and destroy the station, the empire develops a new station with more protective rings. This exciting game runs on 16K systems, employs extensive graphics and sound and can be played by one or two players.

INTRUDER ALERT (Atari only) Price: $15.95 Cassette/$19.95 Diskette

This is a fast paced graphics game which places you in the middle of the "Dreadstar" having just stolen its plans. The droids have been alerted and are directed to destroy you at all costs. You must find and enter your ship to escape with the plans. Five levels of difficulty are provided. INTRUDER ALERT requires a joystick and will run on 16K systems.

MIDWAY (Atari 32K only) Price: $14.95 Cassette/$18.95 Diskette

MIDWAY is an exciting extension of the game of Battleship. It mixes the challenges of strategy and chance. Your opponent can be another human or the computer. Color graphics and sound are both included. Runs in 16K.

NEW

GOLF PRO (Atari only) Price: $17.95 Cassette/$21.95 Diskette

Both realism and beautiful graphics are joined together in GOLF PRO to produce the best golf simulation available. To really appreciate this game, you should have a color TV so that you can see the green of the fairway, the blue of the water hazards, and the white sand of the traps. You tee off with a wood, use your wedge in the sand trap, and putt on the green just as would be done on the course. Show off the Atari to your friends with GOLF PRO. Requires 16K and one joystick.

GAMES PACK I (Available for all computers) Price: $14.95 Cassette/$18.95 Diskette

GAMES PACK I contains the classic computer games of BLACKJACK, LUNAR LANDER, CRAPS, HORSERACE, SWITCH and more. These games have been combined into one large program for ease in loading. They are individually accessed by a convenient menu. This collection is worth the price just for the DYNACOMP version of BLACKJACK.

GAMES PACK II (Available for all computers) Price: $14.95 Cassette/$18.95 Diskette

GAMES PACK II includes the games CRAZY EIGHTS, JOTTO, ACEY-DUCEY, LIFE, WUMPUS and others. As with GAMES PACK I, all the games are loaded as one program and are called from a menu. You will particularly enjoy DYNACOMP's version of CRAZY EIGHTS.

Why pay $9.95 or more per program when you can buy a DYNACOMP collection for just $14.95?

MOON PROBE (Available for all computers) Price: $12.95 Cassette/$16.95 Diskette

This is an extremely challenging "lunar lander" program. The user must drop from orbit to land at a predetermined target on the moon's surface. You control the thrust and orientation of your craft plus direct the rate of descent and approach angle. Runs in 16K Atari.

SPACE TRAP (Atari only, 16K) Price: $14.95 Cassette/$18.95 Diskette

This galactic "shoot 'em up" arcade game places you near a black hole. You control your spacecraft using the joystick and attempt to blast as many of the alien ships as possible before the black hole closes about you.

SUPER SUB CHASE (Atari only) Price: $19.95 Cassette/$23.95 Diskette

SUPER SUB CHASE simulates a search and destroy mission. Set your course and keep an eye on the sonar readings as you hunt for the hidden submarine. Set the depth charge explosion depth and watch them sink towards the sub. This is an addictive game which takes advantage of the Atari's graphics and sound capabilities. One or two players. Joystick(s) required.

TWO PLAYER GAMES

NEW

TWO PLAYER GAMES (Available for all computers; 32K disk/diskette only)

DYNACOMP has acquired the distribution rights to the best eight of Xitrnn's war games. These two-player games were originally written for the North Star computer, but have since been converted to play on all of the computers currently supported by DYNACOMP. Because our licensing and development costs were so low, DYNACOMP offers these programs two to a diskette for only $19.95/diskette, $23.95/disk. If you like war games, then this is a bargain you can not pass up.

Set #1 PANZER and BLITZKRIEG

PANZER

Date: 23 Nov. 1943 Place: Several miles west of Kiev, Russia. The Russians have just liberated Kiev and are moving quickly to reach the German forces which are preparing for a last desperate attempt to halt the Russian advance.

BLITZKRIEG

Date: Spring 1940 Place: Northern France. The German blitzkrieg in the east was complete. Germany had turned its attention to the west: France. The German forces has penetrated the Ardennes and Meuse. The heroism of Dunkirk, the defense of the Aisne-Somme position, and the final collapse of the French armies in the south has all passed. And, now, the drive on Paris.

Set #2 STARSHIP TROOPERS and INVASION OF THE MUD PEOPLE

STARSHIP TROOPERS

Date: Fortieth Century Place: Arachnid planet of Sheol. The first all-out battle on the planet Sheol which will match equal forces of Terran and alien units. The outcome will set the course of the conflict, for the planet of Sheol is a key position in the solar war.

INVASION OF THE MUD PEOPLE

A Peruvian army battalion has been dispatched to a remote village area to investigate the destruction of many local dwellings and the disappearance of most of the villagers. Eye-witnesses have reported strange creatures appearing from scores of slimy mud holes which have oddly begun forming across the terrain.

Set #3 FALL OF THE THIRD REICH and ARMORCAR

FALL OF THE THIRD REICH

Date: March, 1945 Place: Remagen, Germany. The allies under General Eisenhower had reached the Rhine. The Germans had failed in destroying the Ludendorff railroad bridge, allowing several allied divisions to cross before it finally collapsed on March 17 ... and so, the allies began their drive on Berlin.

ARMORCAR

Date: 2 Feb. 1944 Place: Minsk, Russia. A German front-line unit is hard pressed for radio equipment and medical supplies. A relief convoy of armored cars must reach them through partisan-infested territory.

Set #4 MOUNT SURIBACHI and MIDDLE EARTH

MOUNT SURIBACHI

Date: 16 Feb. 1945 Place: Iwo Jima. The Japanese opened fire from Mount Suribachi as the marines landed on the porkchop-shaped island. Gunfire from the hill could cover the entire island, thus it was a critical objective if the Americans were to capture and utilize the all-important air field. Mount Suribachi proved to be one of the most strongly defended positions in the Japanese theatre of war.

MIDDLE EARTH

Date: 1997 Place: MIDDLE EARTH. Through a maze of tunnels, crevices, and rocky passageways discovered leading from an inactive volcano in South America, a team of United Nations' researchers have undertaken a mission to an uncharted frontier: the center of the Earth. After a perilous journey spanning a period of several months, the mission has arrived at the Earth's core, a land of flames, steam, oceans, and unforeseen vegetation. And then the creatures of MIDDLE EARTH appeared ... unmatched by the most frightening horror stories created by man.

MISCELLANEOUS

CRYSTALS (Atari only) Price: $14.95 Cassette/$18.95 Diskette

A unique algorithm randomly produces fascinating graphics displays accompanied with tones which vary as the patterns are built. No two patterns are the same, and the combined effect of the sound and graphics are mesmerizing. CRYSTALS has been used in local stores to demonstrate the sound and color features of the Atari. Runs in 16K.

NORTH STAR SOFTWARE EXCHANGE (NSSE) LIBRARY

DYNACOMP now distributes the 23 volume NSSE library. These diskettes each contain many programs and offer an outstanding value for the purchase price. They should be part of every North Star user's collection. Call or write DYNACOMP for details regarding the contents of the NSSE collection.

Price: $9.95 each; $8.95 each (4 or more)

The complete collection may be purchased for $159.95.

NEW

5¼" DISKETTES (soft sectored/ten sectored) Price: $39.95/20 Diskettes

As you might imagine, DYNACOMP purchases diskettes in large quantities and at wholesale prices. We want to pass the savings along to you!

BUSINESS and UTILITIES

NEW

PORTFOLIO MANAGEMENT (Apple only) Price: $69.95 two Diskettes

The PORTFOLIO MANAGEMENT package was written by a stock broker to help manage portfolios for individual customers. With this program data files can be easily created and kept up to date. A variety of reports can be generated for clients which are attractively and professionally laid out. The user may define his/her own investment categories. PORTFOLIO MANAGEMENT is a top quality, professional tool which will not only provide you with new conveniences but will also serve to enhance your appearance as an efficient and up to date advisor to your clients. Comes complete on two diskettes along with a 30 page instruction manual.

NEW

PERSONAL FINANCE SYSTEM (Available for all computers) Price: $39.95 Diskette

PFS is a single diskette, menu-oriented system composed of ten different programs. Besides recording your expenses and tax deductible items, PFS will sort and summarize expenses by payee, and display information on expenditures by any of 26 user defined codes by month or by payee. PFS will even produce monthly bar graphs of your expenses by category! This powerful package requires only one disk drive, minimal memory (24K Atari, 32K North Star) and will store up to 600 records per disk (and over 1000 records per disk by making a few simple changes to the programs). You can record checks plus cash expenses so that you can finally see where your money goes and eliminate guesswork and tedious hand calculations. Contains high speed machine language sort. PFS has been demonstrated on network (CBS) TV!

FAMILY BUDGET (Apple and Atari only) Price: $34.95 Diskette

FAMILY BUDGET is a very convenient financial record-keeping program. You will be able to keep track of cash and credit expenditures as well as income on a daily basis. You can record tax deductible items and charitable donations. FAMILY BUDGET also provides a continuous record of all credit transactions. You can make daily cash and charge entries to any of 21 different expense accounts as well as to 5 payroll and tax accounts. Data are easily retrieved giving the user complete control over an otherwise complicated (and unorganized!) subject.

NEW

TEXT MASTER (Apple 32K, diskette only) Price: $49.95 Diskette

TEXT MASTER is a general purpose text editor for the Apple II computer. It features powerful, English-oriented commands which permit the complete manipulation of textural information. The information treated may be correspondence, computer programs, data to be used by other programs, and more. TEXT MASTER also interfaces with any printer connected to your Apple. The minimum system requirements are 32K of RAM, Applesoft on ROM, at least one disk, and a lower case adapter. TEXT MASTER can process any length file segment by segment. Thus it is possible to process files as large as a diskette. Comes complete with an efficient 16 page manual. TEXT MASTER is equivalent in capability to many word processing systems costing 3 x or more in price. The commands available in TEXT MASTER are: COLLECT, USE, EXECUTE, NONUM, INSERT, MERGE, STOP, RENUM, DELETE, SAVE, COPY, FREE, REPLACE, WAIT, MOVE, LENGTH, LIST, RESAVE, CLEAR, AUTO, RETRY, APPEND, SET, MANUAL, CHANGE, SCRATCH, SHOW, CATALOG, MODIFY, COMPARE, NUM, DISPLAY, HELP.

INTELINK (Atari only) Price: $49.95 Diskette

This software package contains a menu-driven collection of programs for facilitating efficient two-way communications through a full duplex modem (required for use). In one mode of operation you may connect to a data service (e.g., The SOURCE or MicroNet) and quickly load data such as stock quotations onto your diskette for later viewing. This greatly reduces "connect time" and thus the service charge. You may also record the complete contents of a communications session. Additionally, programs written in BASIC, FORTRAN, etc. may be built off-line using the support text editor and later "uploaded" to another computer, making the Atari a very smart terminal. Even Atari BASIC programs may be uploaded. Further, a command file may be built off-line and used later as controlling input for a time-share system. That is, you can set up your sequence of time-share commands and programs, and the Atari will transmit them as needed, batch processing. All this adds up to saving both connect time and your time.

NEW

PAYFIVE (Apple II plus diskette, two drives required) Price: $149.95

This is an enormously flexible employer payroll system with extraordinarily good human engineering features. PAYFIVE prints checks and computes the required federal, state and local forms for up to 1448 employees. The pay methods may be hourly, salary, commission or any combination. There are multiple options for pay periods, and they also can be used in any combination. PAYFIVE includes many other features and comes extremely well documented with a 200 page manual. The manual may be purchased separately for $30, and that payment later applied to the software purchase.

SHOPPING LIST (Atari only) Price: $12.95 Cassette/$16.95 Diskette

SHOPPING LIST stores information on items you purchase at the supermarket. Before going shopping, it will remind you of all the things you might need, and then display (or optionally print) your shopping list and the total cost. Adding, deleting, changing and storing data is very easy. Runs with 16K.

NEW

TAX OPTIMIZER (Available for all computers) Price: $59.95 Diskette

The TAX OPTIMIZER is an easy-to-use, menu-oriented software package which provides a convenient means for analyzing various income tax strategies. The program is designed to provide a quick and easy data entry. Income tax is computed by all tax methods (regular, income averaging, maximum and alternate minimum tax). The user may immediately observe the tax effect of critical financial decisions. TAX OPTIMIZER has been thoroughly field tested in CPA offices and comes complete with the current tax tables in its data files. TAX OPTIMIZER is tax deductible!

STOCK MASTER/STOCK PLOT (Apple 48K) Price: $59.95 Diskette

This is a full-featured stock portfolio management and analysis system. Ten years of records on up to thirty stocks may be maintained. You may record prices, revenue, earnings/share, ROE, quarterly earnings and dividends, transactions, long/short term gains, P/E, indexes (DJ, S & P, NASDAQ) and MORE! You may plot (HIRES) the price history of any stock against any other, time, or the indexes. Portfolio value may be evaluated at any time. Comes complete with superbly written instructions and sample files on a second diskette.

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TURNKEY is a utility program which allows you to create autoboot/autorun diskettes easily. Simply load and run TURNKEY, load the program diskette to be modified, and answer the questions! The TURNKEY diskette also comes with DOS 2.0 and includes another program, MENU. MENU lists the contents of your diskette alphabetically, and permits the running of any BASIC program on the diskette by typing a single key. TURNKEY and MENU provide you with the ability to run any program on your diskette by simply turning on the computer and pressing a single key.

STOCKAID (Atari only) Price: $29.95 Diskette

STOCKAID provides a powerful set of tools for stock market analysis. With STOCKAID you can display point and figure charts, as well as bar charts with oscillators. You can also examine long term moving averages and on-balance volume features. STOCKAID allows you to input daily data with a single diskette storage capability of 239 days x 16 stocks. Included are stock dividend and split adjustment capabilities. A very professional package!

NEW

NYINDEX (Atari only) Price: $29.95 Diskette

NYINDEX is a comprehensive software package for storing, retrieving and plotting New York Stock Exchange information. The daily data treated includes the composite index, advances, declines, new highs and new lows. Graphical displays include the above plus the index oscillator, cumulative advances/declines and moving averages. Data entry and editing is easy. The diskette includes more than two years of daily data. NYINDEX is an excellent companion to STOCKAID.

PLAYER-MISSILE GRAPHICS TABLET (Atari only) Price: $19.95 Diskette

The PLAYER-MISSILE GRAPHICS TABLET was designed to take the drudgery out of developing four color displays in GRAPHICS MODE 7. No longer will you have to read the locations of those tiny blocks on your graph paper and calculate PLOTs and DRAWTOs. With PMG you will be able to easily design colorful graphic displays with your joystick and save them on diskette for later recall.

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This software package creates a data file of business expenses for equipment which can later be used to calculate and display annual costs, find the present worth, create depreciation schedules and justify tax deductions. The evaluation techniques conform to standards set by federal agencies. This is an invaluable package for any businessman who has invested in equipment. LIFE CYCLE ANALYSIS features an easy to use data file creation section and provides formatted hardcopy reports for use in presentations or for tax record keeping purposes. When used for generating tax information, this package is tax deductible! Requires 48K. Comes on two diskettes.

NEW

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DATA SMOOTHER (Not available for Atari) Price: $19.95 Cassette/$23.95 Diskette

This special data smoothing program may be used to rapidly derive useful information from noisy business and engineering data which are equally spaced. The software features choice in degree and range of fit, as well as smoothed first and second derivative calculation. Also included is automatic plotting of the input data and smoothed results.

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This is a special software package which may be used to evaluate the transfer functions of systems such as hi-fi amplifiers and filters by examining their response to pulsed inputs. TFA is a major modification of FOURIER ANALYZER and examines an engineering-oriented decibel versus log-frequency plot as well as data editing features. Whereas FOURIER ANALYZER is designed for educational and scientific use, TFA is an engineering tool. Available for all computers.

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FOURIER ANALYZER, TFA and HARMONIC ANALYZER may be purchased together for a combined price of $51.95 (three cassettes) and $63.95 (three diskettes).

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PARAFIT is designed to handle those cases in which the parameters are imbedded (possibly nonlinearly) in the fitting function. The user simply inserts the functional form, including the parameters (A(1), A(2), etc.) as one or more BASIC statement lines. Data, results and residuals may be manipulated and plotted as with REGRESSION I. Use REGRESSION I for polynomial fitting, and PARAFIT for those complicated functions.

MULTILINEAR REGRESSION (MLR) (Available for all computers) Price: $24.95 Cassette/$28.95 Diskette

MLR is a professional software package for analyzing data sets containing two or more linearly independent variables. Besides performing the basic regression calculation, this program also provides easy to use data entry, storage, retrieval and editing functions. In addition, the user may interrogate the solution by supplying values for the independent variables. The number of variables and data size is limited only by the available memory.

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BASIC SCIENTIFIC SUBROUTINES, Volumes 1 and 2 (Not available for Atari)

DYNACOMP is the exclusive distributor for the software keyed to the popular texts *BASIC SCIENTIFIC SUBROUTINES, Volumes 1 and 2* by F. Ruckdeschel (see advertisements in BYTE magazine). These subroutines have been assembled according to chapter. Included with each collection is a menu program which selects and demonstrates each subroutine.

Volume 1
Collection #1: Chapters 2 and 3 - Data and function plotting; complex variables and functions
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Collection #3: Chapters 5 and 6 - Random number generators (Poisson, Gaussian, etc.), series approximations
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Volume 2
Collection #1: Chapter 1 - Linear, polynomial, multidimensional, parametric least squares
Collection #2: Chapter 2 - Series approximation techniques (economization, inversion, reversion, shifting, etc.)
Collection #3: Chapter 3 - Functional approximations by iteration and recursion
Collection #4: Chapter 4 - CORDIC approximations to trigonometric, hyperbolic, exponential and logarithmic functions
Collection #5: Chapter 5 - Table interpolation, differentiation and integration (Newton, LaGrange, splines)
Collection #6: Chapter 6 - Methods for finding the real roots of functions
Collection #7: Chapter 7 - Methods for finding the complex roots of functions
Collection #8: Chapter 8 - Optimization by steepest descent
Price per collection: $16.95 Cassette; $18.95 Diskette

All eight collections are available for $99.95 (eight cassettes) and $129.95 (eight diskettes).
Because the texts are a vital part of the documentation, *BASIC SCIENTIFIC SUBROUTINES, Volumes 1 and 2* are available from DYNACOMP:
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See reviews in KILOBAUD, Dr. Dobbs, and ACCESS.

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NEW NEW

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NEW

BEAM DEFLECTION (Available for all computers) (disk/diskette only) Price: $29.95 Diskette/$32.45 Disk

BEAM DEFLECTION is the first in DYNACOMP's new series of structural analysis software packages. It consists of two programs. The first program permits the development of data files which describe the problem. For example, the ends of the beam may be pinned, clamped or free. The beam may be uniformly supported by an elastic bed, or held up by springs variously placed and having differing spring constants. The elasticity and cross section of the beam may vary along its length. The load may be uniformly distributed or it may include discrete forces. The beam may be pinned at various points along its length. And so on. All this information may be easily entered and edited using the data input program.

Following this the analysis program is called. The calculated results are the stress and deflections of the beam, both in numerical and graphical form, since the input data is saved, cases may be easily re-run with modification, thereby permitting iterative design.

The documentation which comes with BEAM DEFLECTION clearly shows how to use the software. In addition, three test problems are described and demonstrated to ensure that you understand how to use the program. Also, helpful theoretical information is supplied in the appendix.

STATTEST (Not available on Atari cassette or for PET/CBM) Price: $19.95 Cassette $23.95 Diskette

This is a statistical inference package which helps you make wise decisions in the face of uncertainty. In an interactive fashion you can build and edit data files and test the differences in means, variances and proportions. STATTEST will also perform data analysis as well as do linear correlation and regression. This menu-directed statistical workhorse is rounded out with a chi-square contingency test and a funiform and normal random sample generator. The documentation is written by a college professor who guides you through the various tests.

ABOUT DYNACOMP

DYNACOMP is a leading distributor of small system software with sales spanning the world (currently in excess of 50 countries). During the past three years we have greatly enlarged the DYNACOMP product line, but have maintained and improved our high level of quality and customer support. The achievement in quality is apparent from our many repeat customers and the software reviews in such publications as COMPUTRONICS, 80 Software (Critique, ANALOG, Softalk, Creative Computing and Kilobaud. DYNACOMP software has also been chosen for demonstration on network television. Our customer support is as close as your phone. It is always friendly. The staff is highly trained and always willing to discuss products or give advice.

CIRCLE 184 ON READER SERVICE CARD

Listing 3.

```
200  REM  ***********************
210  REM  CALCULATION SUBROUTINE
220  REM  ***********************
225 LO = 1
230 I = IN / 12
240 MO = YEARS * 12
250 A = AMOUNT * I * (I + 1) ^ MO / (((I + 1) ^ MO) - 1)
260  DEF  FN MR(X) = ( INT (100 * (X + .005))) / 100
270 A =  FN MR(A)
280 NL = 0:BALANCE(0) = AMOUNT:TIN(0) = 0
290  FOR PMT = LO TO MO
300 I1(PMT) =  FN MR(I * BALANCE(PMT - 1))
310 PRINCIPAL(PMT) =  FN MR(A - I1(PMT))
320  IF PMT <  > MO THEN  GOTO 340
330 PRINCIPAL(PMT) = BALANCE(PMT)
340 BALANCE(PMT) =  FN MR(BALANCE(PMT - 1) - PRINCIPAL(PMT))
350 TIN(PMT) =  FN MR(TIN(PMT - 1) + I1(PMT))
359 ZZ =  PEEK ( - 16384): IF ZZ > 128 THEN LO = PMT + 1: GOTO 370
360  NEXT PMT
370  IF SOURCE$ = "" THEN  INPUT SOURCE$: POKE  - 16368,0
372  IF PMT < MO GOTO 290
```

and permits some parallel processing, it has several disadvantages. The primary disadvantage is that it still requires the user to wait while the computer processes the data. At least in this version the user has something to occupy his time—the prompt displayed before the processing began. But if the user can satisfy this prompt very quickly, he may spend considerable time waiting for the computer to finish its task just as before. This version can be improved by following a second principle of parallel processing.

Second Principle: Interruptable processing. Ideally, priority should be given to the user's time, rather than the computer's After all, we buy computers to save our time, not theirs. This can be accomplished with parallel processing by providing a way for the user to interrupt the computer when he completes his task before the computer completes its task. Once interrupted the computer could, for example, accept user input, reply with yet another prompt, and then return to its processing task while it awaits the next user response.

One technique for achieving interruptable processing by the computer is illustrated in Listing 3. There I have taken the iterative calculation subroutine from Listing 2 and modified it to permit interruptable processing by adding lines 359 and 372 and changing lines 370 and 291.

This routine takes advantage of the ability of the Apple to monitor the current state of the keyboard by reading the contents of decimal memory location -16348. Whenever a key is pressed, the value in this memory location becomes the numeric code of the character typed which is always greater than 128. Referencing a second memory location, -16368 (decimal), clears the first location until another key is pressed.

Line 359 is imbedded within the FOR... NEXT loop and is executed with each loop. This line examines the keyboard memory location to determine whether a key has been pressed, enabling the computer to monitor the keyboard while performing these calculations.

If a key has been pressed, line 359 exits the calculation loop after setting LO equal to the next loop index value, PMT+1. Line 370 checks to make sure the value of SOURCE$ has not already been entered, then prompts the user for the value of SOURCE$ and resets the keyboard memory location. Line 372 returns the program to the calculation subroutine beginning with the next loop if the routine has not already been completed.

The net result of this routine is that if the user presses any key during the execution of this subroutine, the program will respond by halting execution and accepting the user response to the previous prompt, then resume execution until the calculations are completed.

This solution, while better than non-interruptable execution, still has problems. If, for example, the user presses two or more keys before the program halts execution, only the last key will be stored in the keyboard memory location and the user may have to backspace and reenter the response.

Another problem, far more serious than the first, is that the same procedures which increase the efficiency of the program by giving the user unequivocal priority, may themselves introduce inefficiency in other aspects of the program by working at odds with other efficiency-oriented procedures.

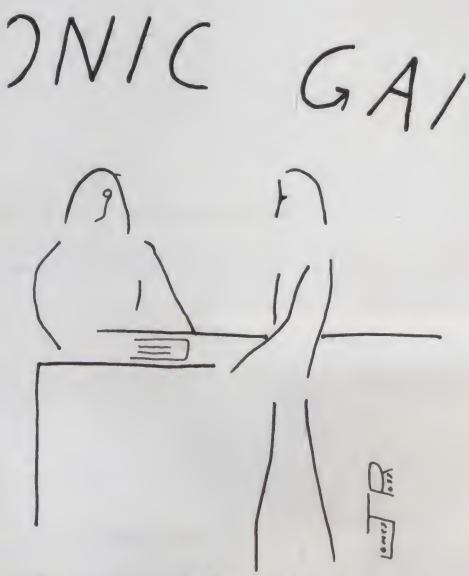
To avoid, or at least minimize, these unanticipated conflicts, it is necessary to coordinate these parallel processing techniques with the other techniques which also increase efficiency so they don't defeat each other. This leads to the third principle of parallel processing.

Third Principle: Coordinate parallel processing with other techniques designed to make programs more efficient. For example, parallel processing should not be allowed to make it necessary to do something more than once, whether it is reading a sector from a disk or performing a calculation, or anything else. A basic principle for integrating parallel processing into programs is that, with few exceptions, it should not make it necessary, to perform any task more than once.

The primary strategy for coordinating parallel processing design with other strategies to produce more efficient programs is to introduce a transition phase into programs when the computer is handling control back over to the user which continues to carry out the processes performed by the central processing unit to the point where they may be most efficiently terminated while still permitting the simultaneous (or at least apparently simultaneous) use of the keyboard by the user. This is done by creating, for this transition phase, a time-sharing capability for the microcomputer.

This strategy is illustrated by the following lines which may be substituted for lines 359, 370, and 372 in Listing 3.

```
359 ZZ = PEEK (-16384): IF ZZ> 128 THEN K$ = K$ + CHR$(ZZ): POKE -16368,0: PRINT CHR$(ZZ);
370 IF K$ =""THEN INPUT SOURCE$
372 IF K$<>"" THEN INPUT ""; SOURCE$: SOURCE$ = K$ + SOURCE$
```



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CIRCLE 211 ON READER SERVICE CARD

If a key is pressed, the new line 359 stores the value of the key in string K$, clears the memory location by referencing decimal location -16368, and prints the value of the key on the screen. Line 372 determines whether one or more keys were pressed during the calculations, and if so, permits the user to input the remainder of the response, then combines that with the string K$ to reconstruct the entire response.

Line 370 permits the user to input the entire response if no keys were pressed during the calculations. This method permits the user to press more than one key on the keyboard and have the response registered even while the calculations are being performed without passing control completely back to the keyboard.

It should be pointed out that, when viewed from within the machine, this is not parallel processing because the computer does not simultaneously perform these calculations and register input data. Instead, this is time-sharing in which both activities are conducted within a very short time interval to give the illusion to the user of simultaneous processes. When viewed from the larger perspective of the man-machine interface, however, this is parallel processing because it permits both the user and the machine to carry on processing activities at the same time.

This revised subroutine monitors the keyboard during lengthy processes by the computer. However, when a key is pressed, rather than immediately returning control to the user, it stores the keys as they are entered in an array, K$, which acts as a buffer. It also prints out the stored keys on the monitor so the user will know they are being registered. Control is not returned fully to the user until the computer is done with its internal processing task.

This strategy has the advantage of permitting the user response to overlap more fully with the internal processing to the computer, minimizing the interruption of the internal processing while still not requiring the user to wait needlessly.

Advantages And Limitations

Parallel processing by the microcomputer and the user offers the opportunity to make running programs more efficient and less frustrating to computer users. It should both reduce waiting time and decrease the overall time required to run any program.

However, parallel processing is not a panacea which will overcome all limitations of microcomputers for all users and for all programs. It will be of little use where the computations or computer activities are already so fast they are almost unnoticed by the user. It will be less useful where it is difficult to anticipate the direction of the program and, hence, difficult to know which prompt to display next, and more useful where there is a clear direction.

Keyboard monitoring routines such as those used in these examples to facilitate parallel processing are most effectively used in program loops. Their use in other time-consuming but noniterative stages of the program may require multiple calls to a monitoring subroutine.

Nor is this technique likely to eliminate all waiting. Most programs are not so balanced that neither the user nor the computer need ever wait. One problem is that different users may interact at very different speeds. For someone less familiar with the program, who reads slower, or who must search through papers for the proper data, the input time may be considerably longer than for the experienced user who has everything at hand and hardly even needs to read the prompts to know what to enter next.

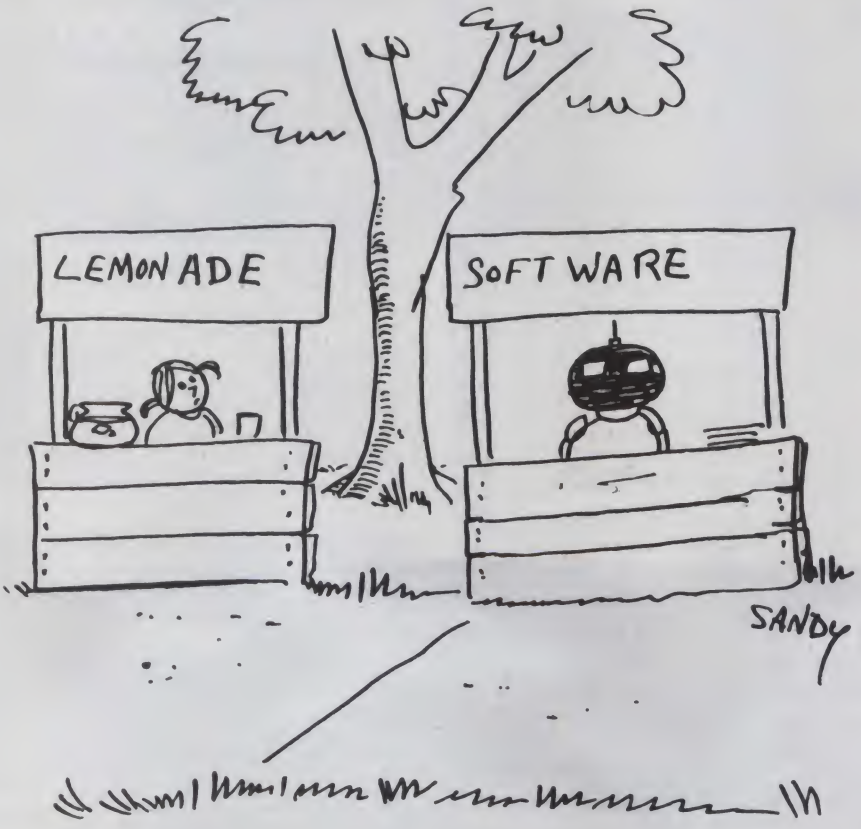
At first, parallel processing appears to conflict with structured programming, sometimes requiring prompts to be separated from related code and placed among seemingly unrelated code. The problem is structured programming, which creates subroutines having only a single function, looks only at the computer part of the process and ignores the user.

With only slight modification it is possible to reconceptualize structured programming as the creation of separate modules or subroutines having a single function for the computer *and* a single function (which may be very different) for the user.

Unless carefully coordinated with other aspects of the program, parallel processing during disk I/O might result in additional disk accesses resulting in more wear and tear on the disk drive and diskettes. This may be minimized with careful monitoring and design of the program. However, parallel processing should be used only where the additional complexity of programming is outweighed by efficiency of operation.

This type of programming may not be for everyone. Just as there are people who enjoy commercials on television so they can take a breather, raid the icebox, or answer the call of nature, some people may like programs with similar built-in pauses when they can do something else.

There is no reason to expect that everyone's work habits will be enhanced by this type of programming. But even the most "laid-back" programmer can be bothered by those times when he must wait long enough to be irritated but not long enough to be productive. Perhaps parallel processing programming could eliminate these awkward gaps to the benefit of us all.



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Implications For The Future

Assuming you use some merit in the concept of parallel processing and want to develop usable routines for your own computer, there still may be some practical difficulties to overcome. For example, in this program for the Apple II, there are several awkward problems with these routines. If keys are pressed in rapid succession while the computer is in its time-sharing routine the routine may not examine the memory register often enough, causing some keystrokes to be missed. Such problems might be resolved by assembly language routines which could work more quickly. But the best solution appears to be to rewrite the console driver to include this capability.

In principle, there should be no reason why one could not write console drivers which encourage and permit such time-sharing and parallel processing in microcomputers, and do so more efficiently than basic subroutines. Such drivers could make it considerably easier for the programmer relieving him of the need to create keyboard monitoring subroutines in the code.

The Apple III console driver is written with just such a feature. It is called a type ahead ability. As many as 128 characters can be entered from the keyboard while the program is processing elsewhere. The characters are processed in sequence when the computer is ready for them. It is even possible to enter several different responses in sequence while awaiting the computer. Each sequence which satisfies a prompt by the computer will be processed, and the remaining characters in the buffer will be saved and interpreted as the response to the next computer prompt. Clearly, this feature makes parallel processing much easier for the Apple III.

However, a console driver by itself is not sufficient to take maximum advantage of parallel processing. It is still necessary for the programmer to reconceptualize the programming task and resequence the activities to coordinate user and computer.

To be most effective, parallel processing program design must go beyond the mere alteration of minor parts of the code. It must also involve a more realistic assessment of the imbalances in the program sequence and develop ways to coordinate user and computer so neither must wait any longer than necessary. Parallel processing is a realistic goal for microcomputing and should be expected of good programs. Perhaps soon we will no longer consider a program "user-friendly" if it requires the user to wait for long periods of time needlessly. □

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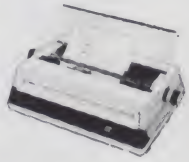

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Searching Techniques

Part 4

Edward Mitchell

A Survey of Sorts

Steve glanced at the display screen of his computer. "Drat!" he exclaimed, "it still isn't finished. That program has been running over an hour, and it still isn't done."

Linda looked up from her desk. "What algorithm are you using?" she asked.

"Just a sort routine I learned in a beginning programming class. Why?" he answered.

"Because maybe you're not using the right one."

"You mean there is more than one way to sort?" Steve blurted out.

"Yeah, there are lots more than just one. Let me see your listing."

Steve handed her a tattered piece of paper, well worn by pencil marked changes. Linda pulled her chair over near his computer and reached for the listing. She recognized it as a typical Bubble Sort, easy to understand, but very inefficient.

"Look," she said, as she drew some lines on a piece of paper. "This steep curve represents your Bubble Sort," she said, pointing to one of the lines. "When the size of your table gets really big, the time it takes to do the sort is huge. But look at this curve down here."

Steve looked, rather skeptically at the other curve. It ran across the paper near the bottom of the graph, increasing only gradually.

"This curve represents Quicksort," said Linda. "Compared to your Bubble Sort, look at how little time it takes. And look at how little the time increases as the table gets bigger."

"Wow!" said Steve. "For my file that would be about 50 times faster. How does Quicksort do it?"

"Looks like your program just finished," responded Linda. "I have some other things I need to work on right now, but maybe I could help you later today."

Edward Mitchell, 720-A Independence Ave., Mountain View, CA 94040.

Steve sighed, feeling mildly perturbed. He finally had a chance but now he would have to postpone it 'til later. Hopefully, they could get things sorted out.

A surprisingly large number of techniques are available to sort data with a computer. The obvious techniques can be very slow when used to sort a large number of records. Better methods such as Shellsort and Quicksort that sort at much higher speeds than the ubiquitous Bubble Sort have been discovered.

As mentioned in the introduction to Part 1, when a problem becomes too large for the computer, we may choose to buy a bigger computer, or we may choose to find a faster method of solving the problem. Several sorting methods run very fast and are not very difficult to program. Their approach to sorting is just not very obvious. Before studying Shellsort and Quicksort, we shall first look at some of the simpler sorts, such as the Bubble, Selection, and Insertion sorts.

Measuring Sort Performance

Because there are so many sorting algorithms, it is apparent that some techniques are better than others. But how much better? By analyzing parameters associated with each algorithm, such as the total number of comparisons and exchanges expected for a list of size n, a simple formula may be derived to indicate the speed of a sort. For example, the Bubble Sort requires on the order of n^2 time to sort a list of n numbers. This means that the time is roughly equal to the size of the list, squared. Doubling the size of n quadruples the length of time to perform the sort (e.g. when n=5, then n^2=25, but when n=10, then n^2=100, or 100/25 — four times longer).

Another way to compare sort performance is to time the sorting algorithms as they sort different sized arrays of data. The resulting times can be plotted against n to give an intuitive notion of their relative speed. Figure 1 presents graphs for four of the sorting methods discussed in this article, comparing the sorting time required by these algorithms.

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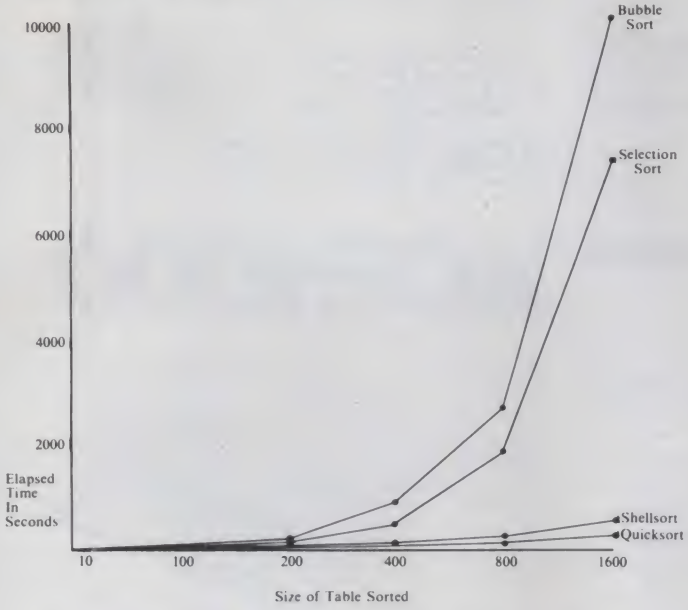

Figure 1. A comparison of running time versus table size for four sorting algorithms. Bubble Sort takes over 10,000 seconds to sort 1600 numbers, while Quicksort takes about 350 seconds.

Keep in mind that when the data records are almost ordered, the sort algorithms may behave much differently than expected, running either much faster or much slower. A sorting technique called Heapsort, has the interesting property that its average and worst case sorting times are nearly the same. Heapsort is not described in this article, but see references Knuth (1973) or Standish (1980).

Of course, how fast the sorting routine operates may be irrelevant, simply because the computer functions so quickly as to make differences in sorting times unnoticeable. In other cases, it may be just fine to let the computer run overnight, in which case it does not matter if the sort is done in one hour or eight hours. It is important to recognize that the difference in sorting performance becomes a factor only as n becomes large, and then only when the time, in human terms, becomes significant.

Figure 1. Data Points.

n =	Quicksort	Shellsort	Selection	Bubble
10	1 sec.	1	1	1
100	16	15	34	46
200	36	38	127	176
400	75	90	490	677
800	161	221	1925	2667
1600	348	530	7365*	10,130*

*Estimated Data Point

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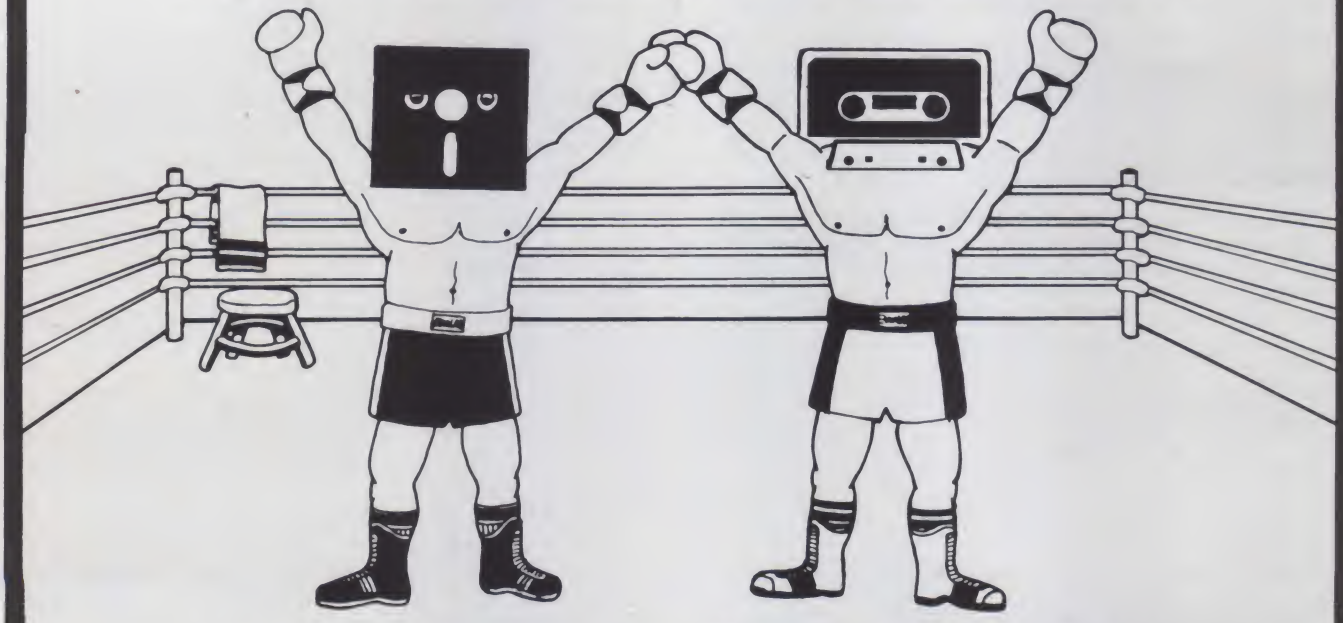

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The Selection Sort

Selection sort is the first sort to be shown in detail. To sort the following array into ascending order,

S1(1)	S1(2)	S1(3)	S1(4)	S1(5)	S1(6)
7	11	12	3	31	9

the selection sort algorithm starts at the left and scans the list, looking for the lowest number. It finds the lowest value at position S1(4)=3. The number 3 is printed, and S1(4) is set to some large number, giving

S1(1)	S1(2)	S1(3)	S1(4)	S1(5)	S1(6)
7	11	12	99999	31	9

By setting S1(4) to 99999, the algorithm is sure to not select the number at S1(4) again. It then repeats the scan, this time choosing 7 at S1(1). The number 7 is printed, and S1(1) is set to a large number.

S1(1)	S1(2)	S1(3)	S1(4)	S1(5)	S1(6)
99999	11	12	99999	31	9

The algorithm loops through the list repeatedly until all the values in S1() are set to the same large value. A simple selection sort might be programmed as shown in Listing 1.

Listing 1. The simple Selection Sort.

```
1000 FOR I = 1 TO N
1010 S = 999999!
1020 FOR J = 1 TO N
1030   IF S1 (J) < S THEN S = S1 (J): L = J
1040 NEXT J
1050 PRINT S1 (L),
1060 S1 (L) = 999999!
1070 NEXT I
1080 RETURN
```

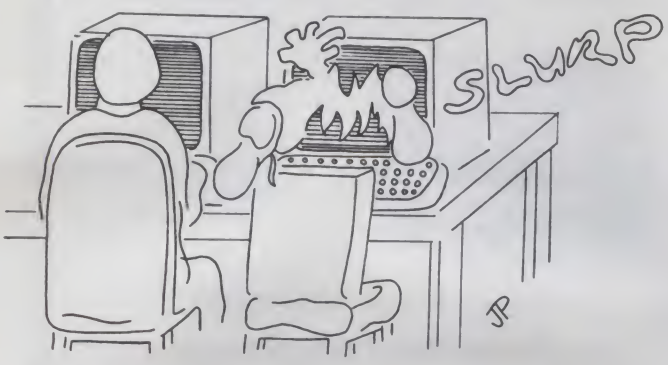
By making a simple change to Listing 1, a second array containing the sorted numbers is produced. By removing lines 1050 and 1060, and adding the line,

1050 S2(I) = S1(J)

Listing 1 will take as input array S1() and produce a second array S2(), containing the sorted list. For large values of n, two arrays will use a great deal of memory.

An improvement can be made so that the second array is not needed. To illustrate, consider the list of numbers,

7	11	12	3	31	9
↑			↑		
(a)			(b)		



"How do you suppose we managed to get such a good deal on these new terminals?"

The arrow at (a) points to the start of the scan. Moving across the list, the algorithm chooses 3 at (b). Rather than printing 3 and setting the corresponding element of the list to 99999, the number is simply exchanged with the number at the start of the list to give,

3	11	12	7	31	9
↑	↑		↑		
(a)	(c)		(b)		

The number at (a) is the lowest number in the list, so the scan now begins at (c). Since 7, at (b), is the lowest number, (b) and (c) are exchanged to give,

3	7	12	11	31	9
↑	↑		↑		
(a)	(c)		(b)		

The selection sort continues in that manner until the entire list is sorted. Listing 2 shows the improved selection sort routine.

Listing 2. The improved Selection Sort.

```
1000 FOR I = 1 TO N
1010 S = 999999!
1020 FOR J = I TO N
1030   IF S1 (J) < S THEN S = S1 (J): L = J
1040 NEXT J
1050 T = S1 (I)
1060 S1 (I) = S1(L)
1070 S1 (L) = T
1080 NEXT I
1090 RETURN
```

Bubble Sort

The Bubble Sort scans the list until finding any number that is lower than the first, not necessarily the lowest overall. Once a number is found, the two values are exchanged, and the algorithm continues searching. For example, using

(1)	(2)	(3)	(4)	(5)	(6)
9	11	12	7	31	3

the scan begins at (1) and compares 9 to the other numbers. As soon as 7 at (4) is found, the two numbers are exchanged.

(1)	(2)	(3)	(4)	(5)	(6)
7	11	12	9	31	3

Resuming at (5), the algorithm scans to (6), where 3 is found to be less than 7. The two numbers are exchanged, giving

(1)	(2)	(3)	(4)	(5)	(6)
3	11	12	9	31	7

At this point the first number in the list is the lowest number. The algorithm begins a second pass at (2), scanning until (4), where an exchange produces,

(1)	(2)	(3)	(4)	(5)	(6)
3	9	12	11	31	7

Finally, (2) is compared to (6) and the two values are exchanged.

(1)	(2)	(3)	(4)	(5)	(6)
3	7	12	11	31	9

Now the first two numbers of the list are in sorted order. Beginning at (3), the Bubble Sort continues to scan the list until all of the numbers are in ascending order. The name Bubble Sort comes from the appearance of the lowest numbers as they percolate or "Bubble" to the front of the list. A Basic program to perform a Bubble Sort is shown in Listing 3.

Listing 3. The Bubble Sort.

```
1000 FOR I = 1 TO N - 1
1010 FOR J = I TO N
1020    IF S1 (J) < S1 (I) THEN T = S1 (J): S1(J) =
        S1 (I): S1(I) = T
1030 NEXT J
1040 NEXT I
1050 RETURN
```

Insertion Sorts

The ordered table binary search from Part 1 is an insertion sort. The ordered table keeps the names in alphabetical order. A new name is added by finding the position at which it should be placed, and then inserting it into the list. To add 13 and 8 into the list,

3 7 9 11 31

just insert each number at the appropriate position. This gives,

3 7 ^ 9 11 ^ 31
8 13

An insertion sort removes one number from the input and inserts it into the sorted output list.

Algorithms 2 and 3, and Listing 2 in Part 1, and Listing 3 in Part 3 of this series illustrate the insertion sort technique using an array of character strings. The same algorithms may be applied to arrays of numbers by changing the string variables to numeric variables.

The insertion sort does not require that any particular data structure or search technique be used. Depending on the requirements of the data, an array, binary tree, or linked list may be used to represent the data, and a sequential, binary or binary tree search may find the position at which to insert the new name.

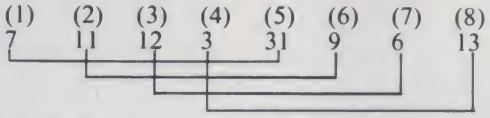
Shellsort

The Shellsort, named for its creator, Donald Shell, divides the list into a large number of small partitions. The numbers within each partition are then sorted into order. For example, if we start with the list,

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
7	11	12	3	31	9	6	13

and partition it into pairs of elements, we get the list,

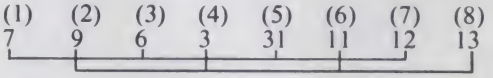
"He can't fool me with all this generosity. He makes it all back selling his computerized mailing list..."



(1) is paired with (5), (2) with (6), (3) with (7) and (4) with (8). For each pair, the two elements are arranged into order. Exchanging (2) and (6), and (3) and (7) produces the list,

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
7	9	6	3	31	11	12	13

Next, the partitions are doubled in size so that each contains four elements, giving



The four elements within each of these partitions are sorted to give,

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
6	3	7	9	12	11	31	13

Finally, the partitions are doubled again, this time to encompass the entire list. Before sorting the final partition, note that the list is almost sorted. The first four elements, while in the wrong positions are indeed the first four elements of the sorted list. The final list shown below is produced by interchanging 3 adjacent pairs of numbers at locations (1) and (2), (5) and (6), and (7) and (8).

3 6 7 9 11 12 13 31

The Shellsort is shown as a Basic program in Listing 4. The variable D is the distance between elements within a single partition. Statement 1050 selects the partition to sort, while statements 1060 through 1110 sort the elements of the partition.

Listing 4. The Shell Sort. This is essentially Algorithm 201 "Shell Sort" from the Collected Algorithms of the CACM.

```
1000 D=4
1010 IF D< N THEN D = D + D:GOTO 1010
1020 D = D - 1
1030 D = INT (D/2)
1040 IF D < 1 THEN RETURN
1050 FOR J = 1 TO N - D
1060   FOR I = J TO 1 STEP -D
1070      IF S1(I + D) > S1(I) THEN GOTO 1120
1080      T= S1(I)
1090      S1(I) = S1(I + D)
1100      S1(I + D) = T
1110  NEXT I
1120 NEXT J
1130 GOTO 1030
```

Quicksort

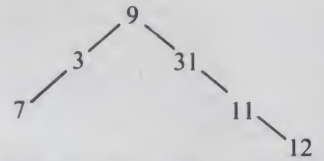
The Bubble Sort algorithm requires n^2 time to sort a list of n entries. If the list is split in two, the problem becomes one of sorting two smaller lists, each taking $(1/2n)^2$ time. If n = 10, then Bubble Sort takes $n^2 = 100$ time to sort the list. Dividing the list into two smaller lists of n=5 gives a sorting time of $5^2 + 5^2 = 50$, which is less than the original (neglecting the problem of merging the two sorted lists together after the sort).

The Quicksort algorithm, invented by C.A.R. Hoare, uses a divide and conquer approach to divide the list into successively smaller subproblems. To divide the list, a number called the pivot value is chosen. All numbers less

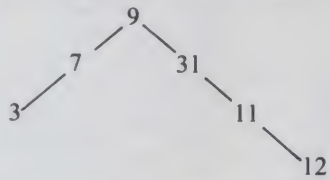
than the pivot are placed to the left and all numbers greater than the pivot are placed to the right. To sort the list of six numbers,

9 31 11 7 12 3

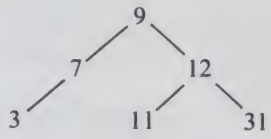
we choose the first number in the list, 9, as the pivot value. All the numbers less than 9 are arranged to the left of the pivot value and all the numbers that are greater are arranged to the right, giving two partitions. Using a tree to graphically depict the operation of Quicksort, the partitioning is easily observed,



The first partitioning produces two new partitions. Each of these partitions becomes a new subproblem to be subdivided further. Since there are just two numbers in the left subbranch, they are easily sorted to give,



The next step is to select a pivot point for the right subbranch and partition it in two sections. Choosing 12 as the pivot value, the right branch is partitioned into,



After only three partitions, the list is sorted into the tree shown above. Traversing the tree from left to right yields the sorted list.

Selecting the Pivot Value

Several modifications have been made to Quicksort, particularly with respect to the selection of the pivot value. Ideally, the pivot should be equal to the median of the list, so that it yields two nearly equal partitions. One simple selection is to choose the first value in the list as the pivot point. Unfortunately, if the list is nearly sorted, which is often the case, that choice is a poor selection since it will probably be the lowest number in the list. Attempting to partition on that value will have no effect since all numbers greater than it are already to its right.

Another candidate is the last value in the list, but for similar reasons, it may be a very poor choice when the *list is* almost sorted. If the list is expected to be almost sorted, then choosing the middle entry as a pivot would be a good choice. Other choices include averaging the first, last and middle elements of a partition or averaging a random sample from the list.

Programming Quicksort

Rather than using a tree structure for Quicksort, it is much faster and easier to use an array based version, especially when coding in a language like Basic. Let the numbers

9 31 11 7 12 3

be contiguous numbers in an array. To partition the array, select 9 as the pivot value and reorder the array as,

9 3 7 11 12 31
<9 >9

The first three numbers are all less than or equal to the pivot, 9, and the last three numbers are all greater.

To perform an array based partitioning, create two pointers I and J, and set them as shown below.

9 31 11 7 12 3
I J

Let X have the pivot value of 9. Advance I to the right until finding a number greater than the pivot, X. This yields,

9 31 11 7 12 3
I J

Next, decrement J to the left until finding a number less than the pivot. In this case, 3 is less than 9, so J does not need to move. Exchange the two numbers pointed to by I and J, giving,

9 3 11 7 12 31
I J

Repeat the procedure, advancing I to the right. Then decrement J to the left until reaching a number less than 9.

9 3 11 7 12 31
I J

The two numbers are exchanged and the first partition is completed, giving two new partitions,

9 3 7 11 12 31
I J

All numbers at or to the left of I are less than or equal to 9, and those to the right are greater. It is now up to the Quick Sort algorithm to sort the two smaller sections. The easiest way to do that is to have Quick Sort call itself to partition and sort each of the two smaller sections.

Quicksort is shown in Algorithm 1. After the first partitioning, Quicksort will call itself recursively to sort the two smaller sections. Unfortunately, with a Basic program, the solution can not be quite that simple. For example, the Quicksort subroutine sorts the numbers between L and R, but as soon as Quicksort is called again, the old values of L, R, I, and J will be lost when set to the edges of the new partition. Obviously, the values need to be saved before calling Quicksort. An initial solution

Algorithm 1
Quicksort (L,R)
On entry L is the lower bound of a partition and R is an upper bound. This algorithm sorts the numbers in the array S1() between L and R. The partitioning routine is described in the text and shown in Listing 5.

Step Action
1) Partition (L,I,J.R)
2) IF R-L=1 Then
IF S1(R) S1(L) Then Exchange S1(R), S1(6)

Else
Quicksort (L,I)
Quicksort (J,R)

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```
1000 REM - QUICKSORT
1010 IF L >= R - 1 THEN GOTO 1160
1020 REM - SUBR 2000 PARTITIONS THE SEGMENT BETWEEN L AND R
1030 GOSUB 2000
1040 IF J > R THEN GOTO 1170
1050 P = P + 2 : REM - PUSH J AND R ON TO STACK
1060 S (P) = J: S (P-1) = R
1070 R = I
1080 REM - CALL QUICKSORT TO SORT THE SEGMENT BETWEEN L AND I (R NOW EQUALS I)
1090 GOSUB 1000
1100 L = S (P): REM - RESTORE L = J AND R FROM THE SAVED VALUES ON STACK
1110 R = S (P - 1)
1120 GOSUB 1000
1130 REM - POP THE SAVED DATA FROM THE STACK
1140 P = P - 2: RETURN
1150 REM - IF ONLY 2 ELEMENTS THEN PERFORM QUICK COMPARISION SORT
1160 IF R - L = 1 THEN IF S1(R) < S1(L) THEN T = S1(L): S1(L) = S1(R): S1(R) =T
1170 RETURN
2000 REM
2010 REM
2020 REM
2030 REM
2040 REM - PARTITION THE SEGMENT BETWEEN L AND R, RETURNING I AND J
2050 I = L: J = R
2060 X = (S1(I) + S1(J) + S1((I + J)/2))/3: REM - COMPUTE PIVOT VALUE
2070 REM - INCREMENT I UNTIL FINDING AN S1(I) > THAN X
2080 IF I > N THEN GOTO 2170
2090 IF S1(I) < X THEN I = I + 1: GOTO 2080
2100 REM
2110 REM - DECREMENT J UNTIL FINDING AN S1(J) < THAN X
2120 IF J < M THEN GOTO 2170
2130 IF S1(J) > X THEN J = J - 1: GOTO 2120
2140 REM
2150 REM - IF NEEDED, THEN EXCHANGE THE VALUES AT S1(I) AND S1(J)
2160 IF I < J THEN T = S1(I): S1(I) = S1(J): S1(J) = T: I = I + 1: J = J - 1: GO
TO 2080
2170 I = J: J = J + 1: REM - RETURN I AND J AT EDGES OF PARTITIONS
2180 RETURN
```

*Listing 5. Quicksort. To use Quicksort, set L=1, and R=n (the number of elements in the table to sort) and do a GOSUB 1000. Array S() may be defined as DIM S (2*n), and used as a stack to store the edges of subproblems still to be solved.*

might be to write something like,

```
R1 = R
J1 = J
```

as a way of saving the values of R and J. But what happens if the call to Quicksort, in turn, causes another call to Quick Sort? Ultimately, R1 and J1 will be set to some other values.

The solution is to store R and J on a stack. Each time Quicksort is called, R and J are pushed. For example, to sort the original list, L and R are 1 and 6, respectively. After calling the partitioning routines, two new partitions are created: 1 to 3, and 4 to 6. Quicksort is called recursively to sort each of the two subproblems. The necessary values are placed on the stack, and Quicksort is called. On return, the original values are restored from the stack.

A Basic implementation of Quicksort is shown in Listing 5. The size of the stack S() can be reduced by calling Quicksort to sort the smaller of the two intervals first. This trick is described further in Standish (1980).

Sorting Strings and Files

All of the examples shown so far sort arrays of numbers, but they can also be used with arrays of character strings and with records in disk files. By changing the appropriate variables, the Bubble Sort shown in Listing 2 is altered to sort character strings (see Listing 6(a)).

Unfortunately, sorting character strings is very inefficient because entire strings must be shifted around in memory. Microcomputers (and most large computers, too) do not perform that operation very well. But we don't have to move the strings around. Instead, an array of pointers or indexes is used to point to each name in the array to be sorted. (See Part 2 for an explanation of pointers). Then the pointers are exchanged, rather than the strings. An example makes this clear. Let D$() be the array of names,

D$(1)	D$(2)	D$(3)	D$(4)	D$(5)
LISA	ALAN	GEORGE	TED	ALICE

Let P() be an array of pointers, initially set as,

P(1)	P(2)	P(3)	P(4)	P(5)
1	2	3	4	5

Now, to sort the list of names, exchange the pointer locations as shown,

P(1)	P(2)	P(3)	P(4)	P(5)
2	5	3	1	4

After the sort, D$() is unchanged, only the P() values have been exchanged. Note that D$(P(1))=ALAN, which is the first name in the sorted list and D$(P(2))=ALICE, which is the second name. Verify for yourself that D$(P(I)), for I equals 1 to 5, does, indeed, yield the sorted list of names. A Bubble Sort using pointers is shown in Listing 6(b). Not shown is the initialization of each of the P(I) values to I, for I equals 1 to N, which is accomplished with a single FOR-NEXT loop. The same technique may be applied to all of the string sorts and as a means of improving the execution time of Algorithms 2 and 3 in Part 1 of this series.

Pointers should be used when sorting records in a data file. Rather than reading a record from the file and then exchanging it with another record elsewhere in the

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6	BREAKEVN	Breakeven analysis
7	DEPRSL	Straightline depreciation
8	DEPRSY	Sum of the digits depreciation
9	DEPRDB	Declining balance depreciation
10	DEPRDDB	Double declining balance depreciation
11	TAXDEP	Cash flow vs. depreciation tables
12	CHECK2	Prints NEBS checks along with daily register
13	CHECKBK1	Checkbook maintenance program
14	MORTGAGE/A	Mortgage amortization table
15	MULTMON	Computes time needed for money to double, triple, etc.
16	SALVAGE	Determines salvage value of an investment
17	RRVARIN	Rate of return on investment with variable inflows
18	RRCONST	Rate of return on investment with constant inflows
19	EFFECT	Effective interest rate of a loan
20	FVAL	Future value of an investment (compound interest)
21	PVAL	Present value of a future amount
22	LOANPAY	Amount of payment on a loan
23	REQWITH	Equal withdrawals from investment to leave 0 over
24	SIMPDISK	Simple discount analysis
25	DATEVAL	Equivalent & nonequivalent dated values for oblig.
26	ANNUDEF	Present value of deferred annuities
27	MARKUP	% Markup analysis for items
28	SINKFUND	Sinking fund amortization program
29	BONDVAL	Value of a bond
30	DEPLETE	Depletion analysis
31	BLACKSH	Black Scholes options analysis
32	STOCVAL1	Expected return on stock via discounts dividends
33	WARVAL	Value of a warrant
34	BONDVAL2	Value of a bond
35	EPSEST	Estimate of future earnings per share for company
36	BETAALPH	Computes alpha and beta variables for stock
37	SHARPE1	Portfolio selection model-i.e. what stocks to hold
38	OPTWRITE	Option writing computations
39	RTVAL	Value of a right
40	EXPVAL	Expected value analysis
41	BAYES	Bayesian decisions
42	VALPRINF	Value of perfect information
43	VALADINF	Value of additional information
44	UTILITY	Derives utility function
45	SIMPLEX	Linear programming solution by simplex method
46	TRANS	Transportation method for linear programming
47	EOQ	Economic order quantity inventory model
48	QUEUE1	Single server queueing (waiting line) model
49	CVP	Cost-volume-profit analysis
50	CONDPROF	Conditional profit tables
51	OPTLOSS	Opportunity loss tables
52	FQUOQ	Fixed quantity economic order quantity model
53	FQEOWSH	As above but with shortages permitted
54	FQEOQPB	As above but with quantity price breaks
55	QUEUECB	Cost-benefit waiting line analysis
56	NCFANAL	Net cash-flow analysis for simple investment
57	PROFIND	Profitability index of a project
58	CAP1	Cap. Asset Pr. Model analysis of project
59	WACC	Weighted average cost of capital
60	COMPBAL	True rate on loan with compensating bal. required
61	DISCBAL	True rate on discounted loan
62	MERGANAL	Merger analysis computations
63	FINRAT	Financial ratios for a firm
64	NPV	Net present value of project
65	PRINDLAS	Laspeyres price index
66	PRINDPA	Paasche price index
67	SEASIND	Constructs seasonal quantity indices for company
68	TIMETR	Time series analysis linear trend
69	TIMEMOV	Time series analysis moving average trend
70	FUPRINF	Future price estimation with inflation
71	MAILPAC	Mailing list system
72	LETWRT	Letter writing system-links with MAILPAC
73	SORT3	Sorts list of names
74	LABEL1	Shipping label maker
75	LABEL2	Name label maker
76	BUSBUD	DOME business bookkeeping system
77	TIMECLCK	Computes weeks total hours from timeclock info.
78	ACCTPAY	In memory accounts payable system-storage permitted
79	INVOICE	Generate invoice on screen and print on printer
80	INVENT2	In memory inventory control system
81	TELDIR	Computerized telephone directory
82	TIMUSAN	Time use analysis
83	ASSIGN	Use of assignment algorithm for optimal job assign.
84	ACCTREC	In memory accounts receivable system-storage ok
85	TERMSPAY	Compares 3 methods of repayment of loans
86	PAYNET	Computes gross pay required for given net
87	SELLPR	Computes selling price for given after tax amount
88	ARBCOMP	Arbitrage computations
89	DEPRSF	Sinking fund depreciation
90	UPSZONE	Finds UPS zones from zip code
91	ENVELOPE	Types envelope including return address
92	AUTOEXP	Automobile expense analysis
93	INSFILE	Insurance policy file
94	PAYROLL2	In memory payroll system
95	DILANAL	Dilution analysis
96	LOANAFFD	Loan amount a borrower can afford
97	RENTPRCH	Purchase price for rental property
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file, simply rearrange the pointers. Listing 6(c) shows another version of Bubble Sort set up to sort a disk file. The program in 6(c) was written and run on an Osborne 1 personal computer.

Listing 6(a). A simple change may be made to any of the sort routines to sort character strings. Shown in (a) is a modified Bubble Sort. In (b) pointers (described in the text) are used to make the implementation somewhat faster.

```
1000 FOR I = 1 TO N - 1
1010 FOR J = I TO N
1020    IF S$ (J) < S$ (I) THEN T$ = S$ (J): S$(J) =
        S$ (I): S$ (I) = T$
1030 NEXT J
1040 NEXT I
1050 RETURN
```

Listing 6(b).

```
1000 FOR I = 1 TO N - 1
1010 FOR J = I TO N
1020    IF S$ (P(J)) < S$ (P(I)) THEN T = P (J): P(J)
        = P (I): P (I) = T
1030 NEXT J
1040 NEXT I
1050 RETURN
```

Listing 6(c).

```
10 N=25
20 DIM P(N)
30 OPEN "R", #1, "SORTFILE",8
40 FIELD #1, 8 AS R$
50 ' CREATE RANDOM DATA IN THE FILE
60 FOR I=1 TO N
70   RSET R$=STR$(INT(RND*1000))
80   PUT #1, I
90 NEXT I
100 ' SET UP THE POINTERS
110 FOR I=1 TO N
120   P(I)=I
130 NEXT I
140 ' GO DO THE SORT
150 GOSUB 1010
160 ' PRINT OUT THE SORTED TABLE
170 FOR I=1 TO N
180   GET #1, P(I)
190   PRINT R$
200 NEXT I
210 STOP
1000 ' DO BUBBLE SORT ON THE RECORDS, EXCHANGING
     POINTERS
1010 FOR I=1 TO N
1020   GET #1, P(I)
1030   R1$=R$
1040   FOR J=I TO N
1050     GET #1, P(J)
1060     IF R$ < R1$ THEN T=P(J): P(J)=P(I): P(I)=T:
         GET #1, P(I): R1$=R$
1070   NEXT J
1080 NEXT I
1090 RETURN
```

Sorting on Fields

Normally, sorting is not performed on simple data objects such as single names or arrays of numbers, but on complex groups of data called records. A typical record might have the layout shown in Figure 2. If a data file having records such as R$ is sorted using the string sorts described so far, an alphabetic ordering, based on the last name and then the first name is produced.

Suppose that the file should be sorted by zip code, instead of name. Then, all comparisons are made using just the 5-byte field containing the zip code. A more complicated sort might be based on several fields. For example, suppose a business needed to sort its customer records by city, and then by zip code within each city, and then by customer name within each of the zip code areas.

Figure 2. Typical Customer Record.

R$=	Name	Address	City	Zip Code
	32 bytes	24 bytes	16 bytes	5 bytes

Sorting on fields. When the records to be sorted have more than a single name, the sort may be made on an individual field within the record. In some cases, the sort may be made on several fields. For example, a business may wish to sort by zip code and then by name within each zip code area.

Three comparisons must be made for each record. First the city field, then the zip code field, and finally the name field.

Summary

Numerous sorting techniques are available to organize tables or files of data records. Shellsort is generally the easiest to implement in the Basic language, and provides sufficient speed to sort fairly large tables. Quicksort is slightly more difficult to program in Basic because it must maintain its own stack to manage the partitioning. Yet it is easily programmed in languages like Pascal, Ada, and Algol.

Nevertheless, the slow and less efficient sorts, such as Bubble Sort and Selection Sort, can be very useful for small tables. The Insertion Sorts, especially the Binary Ordered Table algorithms, provide efficient methods of table searching, while simultaneously sorting the data into alphabetic or numeric order. Although not shown in the examples, the algorithms are easily altered to sort tables into descending order, usually by changing a less than symbol to a greater than symbol, or vice versa.

This four-part series has covered searching, sorting, and data structures. Several techniques have been presented to manipulate data using inobvious but fast methods of processing. I hope these techniques will prove useful in solving your programming problems. Data structures are the foundation of much of the work in computer science. Knowing about data structures and how to use them makes learning about other areas of computering much easier.

The references shown at the end of each section provide a ready source of additional information for the curious reader.

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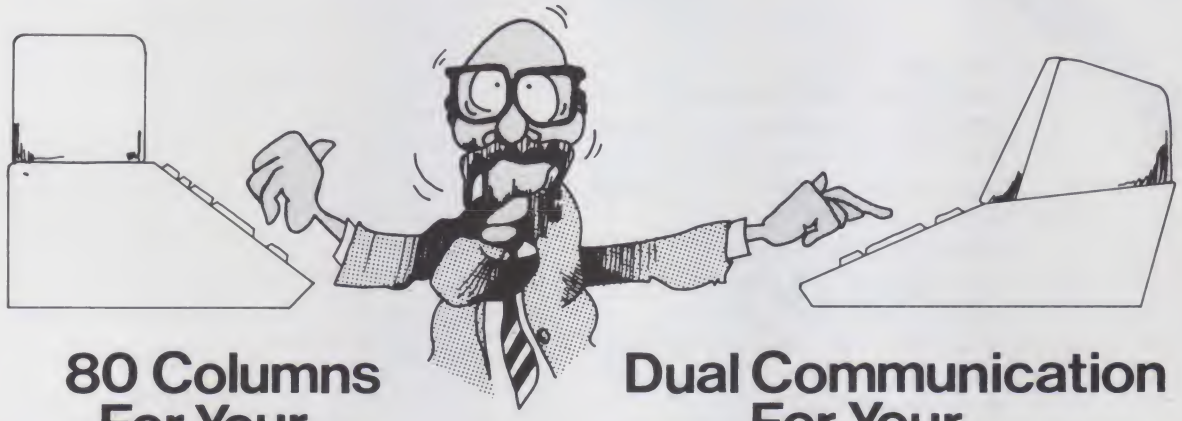

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The Monkey and The Hunter

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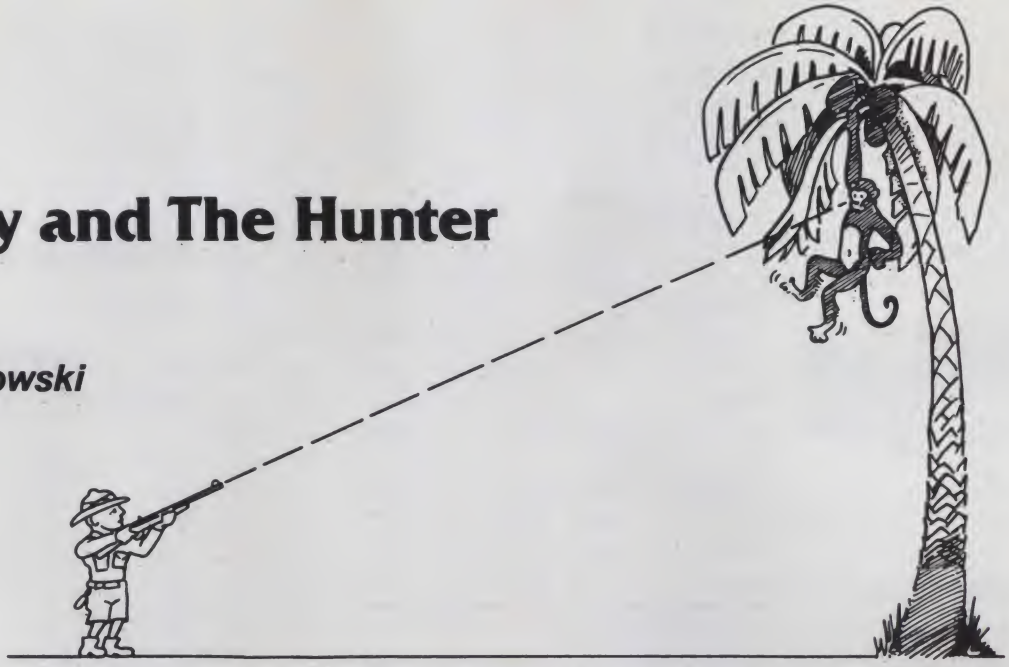

One of the classic problems posed to students of physics is the quandary of the monkey and the hunter. It is a study in the mechanics of projectile motion. Embodied in the solution are elements of geometry, trigonometry, ballistics, projectile mechanics, vector analysis and in this case, a new twist, some elementary computer graphics.

The problem goes something like this. A hunter is deep in the darkest woods in search of a rare breed of monkey. He is armed with bullets which do not kill. They merely subdue monkeys temporarily so they can be packed and shipped to game farms and zoos. These monkeys have extremely keen vision and extraordinary reflexes. They can actually see a bullet leave the end of a rifle barrel. The monkeys can usually be found hanging leisurely from the branches of the tallest trees. When they catch sight of the hunter's bullet—long before the sound of the exploding gunpowder has reached their ears—they release their grip on the branch and fall to earth. Where, then, should the hunter aim to assure that the bullet will strike the monkey?

Physics Apparatus

I offer this problem in a computer magazine because a small micro-computer is an excellent tool for the analysis of the motion of both bullet and monkey. Physics teachers have posed this problem—much to the delight of their students—for years. They have continually devised methods for illustrating the mechanics of this problem. The closer the experiment to the real thing, the more the students like it. I have built launchers from scrap lumber, laboratory tubing, blow guns, straws, photocells, wire, batteries and electromagnets. I have seen monkeys made from styrofoam, balsa wood, rubber, plastic, steel and even an old sock. I have used chalk, pencils, rubber darts, real darts, pins, nails, corks and other material for projectiles. With these devices the action is realistic but over very quickly. Oh, not as quickly as if I rented a real monkey and used real bullets in the real deep dark woods. Even a blow gun projectile moves too fast for the human eye to study. You can follow the motion but you can't study it. But the results are the same. Students learn quickly that the only way to hit the monkey is to aim straight at him. Seems logical! But many students think you should aim under the monkey. They think monkeys fall faster than bullets. Sometimes the chalk will bounce off the monkey and evidence of a direct hit is circumstantial. That's where the old sock comes in. If you make the monkey from an old sock around a steel embroidery ring, the sock can be used to catch the projectile. The metal ring is suspendable from an electromagnet. There's no denying a direct hit then. Back issues of *The Physics Teacher* abound with new ideas for demonstrating this delightful problem.

Despite all this apparatus I always felt that much could be learned from a detailed analysis of the motion of both bullet and monkey as they came under the influence of gravity. I've even tried photographing the whole scheme as a time exposure. That was cumbersome and never seemed to be worth the effort for the pictures I got.

With the advent of the inexpensive micro, with decent graphics resolution, it is possible to take a new look at this old problem in a straightforward but novel way.

The Plan

So, I should like to describe below my analysis of the situation. First, I shall prove, with some mathematical rigor, that the only way to hit the monkey is to aim directly at him. Then, I shall offer some empirical proof that this mathematical contention is borne out by the facts. I include several computer programs to look at the motion tabularly. Finally, I offer two programs which allow the entire motion of the projectile and the monkey to be displayed in real time on your micro. These programs can be used on any computer system with even a moderate graphics capability. However, I ran and debugged these particular programs only on the TRS-80 Color Computer with Extended Color Basic and on the Atari 800.

The lessons learned here can be extended far beyond this particular problem. If you want to add realism to any games you are writing, you may wish to include the influence which gravity exerts on bodies in motion. The equations developed below actually describe the real motion of projectiles and other falling objects. In fact, the key to understanding the solution to this problem is embodied in that very thought. Projectiles, like monkeys who've released their grip, are actually falling bodies, even as they speed away from the ground.

Steve Rogowski, Computing Center, State University of New York at Albany, Albany, N.Y. 12222

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The program allows the user to select the initial velocity of the bullet, the aiming angle and the time window. It is possible to select parameters which will not result in a successful hit even when aiming at the monkey. That's what makes this problem so interesting. The bullet must have enough initial velocity to reach the target. It must also hit the monkey before the monkey hits the ground. Although an interesting question can be posed here. Can the monkey hit the ground and be struck later by the bullet if he doesn't flee?

Try using 200 feet per second as a starting point for muzzle velocity. This works well with the 300 foot range and 150 foot elevation. Extremely fast initial velocities cause the bullet to make contact with the monkey even as he lets go of the branch.

The program will compute the correct aiming angle for you, in case you wish to vary x and y in lines 130 and 140. It is just a recommendation though. You may use any aiming angle you choose. The value recommended is stored in $T2$ and is in degrees. You may aim anywhere you like as the INPUT statement in line 210 suggests. Line 220 converts your angle of fire from degrees to radians. Line 250 allows you to look at whatever slice of time you choose. Be careful to select a small enough increment. This will ensure that the time of impact is covered by the time scan and not simply bypassed. You see it's possible to look at such large increments of time that bullet and monkey meet at some time in between the ones you've printed.

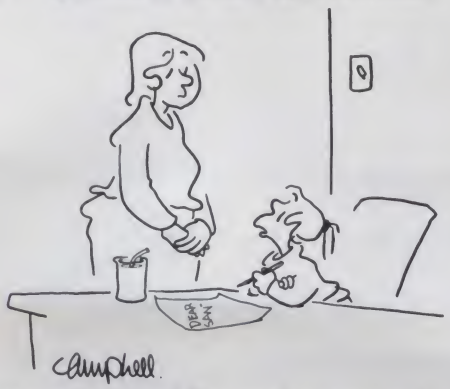
In program lines 300-330, $(X1, Y1)$ represent (x_b, y_b) and $(X2, Y2)$ stand for (x_m, y_m). The value of $g = 32$ ft/sec^2 is set in line 150.

Testing on lines 350-390 stops the printing when either the bullet or the monkey strikes the ground. A much more refined set of tests is left as an exercise for the reader.

The most important test comes in lines 400-410. Here the bullet and the monkey are required to be within 1.1 feet of each other both vertically and horizontally. The constant 1.1 can be adjusted to reflect the size of the monkey and your tolerance for error. A bigger value will be more forgiving. Don't just test to see if $X1 = X2$ and $Y1 = Y2$. Basic will not consider them equal if they differ in the fifth decimal place. That kind of accuracy is the difference between hitting the monkey in the nose or on the lip.

PROGRAM 1

```
100 PRINT
110 PRINT 'INPUT MUZZLE VELOCITY OF BULLET (TRY 200 TO
    START)';
120 INPUT V
130 X=300       @DISTANCE FROM TREE TO HUNTER
140 Y=150       @HEIGHT OF MONKEY ABOVE GROUND
150 G=32        @ACCELERATION DUE TO GRAVITY OF 32
    FT/SEC12
160 T2=ATN(Y/X)*57.29578  @ANGLE OF ELEVATION OF MONKEY
    IN DEGREES
170 PRINT
180 PRINT 'MONKEY IS ELEVATED AT AN ANGLE OF ';T2;' DEGREES
    FROM HUNTER'
190 PRINT
200 PRINT 'INPUT ANGLE OF ELEVATION FOR FIRING ';
210 INPUT A
220 A1=A/57.29578   @CONVERT TO RADIANS
230 PRINT
240 PRINT 'SPECIFY START TIME, END TIME, INCREMENT'
250 INPUT B,L,N
260 PRINT
270 PRINT 'TIME','BULLET (X)','BULLET (Y)','MONKEY (X)','MONKEY
    (Y)'
280 PRINT
290 FOR T=B TO L STEP N
300 X2=X        @MONKEY'S X-POSITION AT TIME T
310 Y2=Y-(.5*G*T!2)   @MONKEY'S Y-POSITION AT TIME T
320 X1=V*COS(A1)*T    @BULLET'S X-POSITION AT TIME T
330 Y1=V*SIN(A1)*T-(.5*G*T!2) @BULLET'S Y-POSITION AT TIME
    T
340 PRINT T,X1,Y1,X2,Y2
350 IF Y2<0 THEN PRINT 'MONKEY LANDED SAFELY (TRY FASTER
    BULLET)'
360 IF Y2<0 THEN PRINT '(OR AIM MORE ACCURATELY!)'
370 IF Y2<0 AND Y1>=0 THEN 440
380 IF Y2>0 AND Y1<0 THEN PRINT 'BULLET HIT GROUND
    ';X-X1;'FT SHORT'
390 IF Y2>0 AND Y1<0 THEN 440
400 IF ABS(X1-X2)<1.1 AND ABS(Y1-Y2)<1.1 THEN PRINT 'YOU
    GOT HIM!'
410 IF ABS(X1-X2)<1.1 AND ABS(Y1-Y2)<1.1 THEN 440
420 NEXT T
430 PRINT 'YOU DID NOT HIT THE MONKEY IN THE TIME FRAME
    SCANNED!'
440 PRINT
450 PRINT 'DO YOU WANT TO TRY ANOTHER SET OF INPUTS
    (YES=0, NO=1)'
460 INPUT W
470 IF W=0 THEN 100
480 END
```



"Why do I have to write to Santa? Why can't I just enter my requests into his computer?"

Below is a table generated by the program above from the input which follows:

INPUT MUZZLE VELOCITY OF BULLET
(TRY 200 TO START)? **200**

MONKEY IS ELEVATED AT AN ANGLE OF
26.565052 DEGREES FROM HUNTER

INPUT ANGLE OF ELEVATION FOR FIRING? **26.565052**

SPECIFY START TIME, END TIME, INCREMENT
? **1.6,1.8,.01**

TABLE 1
MUTUAL POSITION OF BULLET AND MONKEY (Case 1)
DIRECT AIM

TIME	BULLET (X)	BULLET (Y)	MONKEY (X)	MONKEY (Y)
1.60	286.21670	102.14835	300	109.0400
1.61	288.00555	102.52918	300	108.5264
1.62	289.79440	102.90680	300	108.0096
1.63	291.58326	103.28123	300	107.4896
1.64	293.37211	103.65246	300	106.9664
1.65	295.16096	104.02048	300	106.4400
1.66	296.94981	104.38531	300	105.9104
1.67	298.73867	104.74694	300	105.3776
1.68	300.52752	105.10537	300	104.8416

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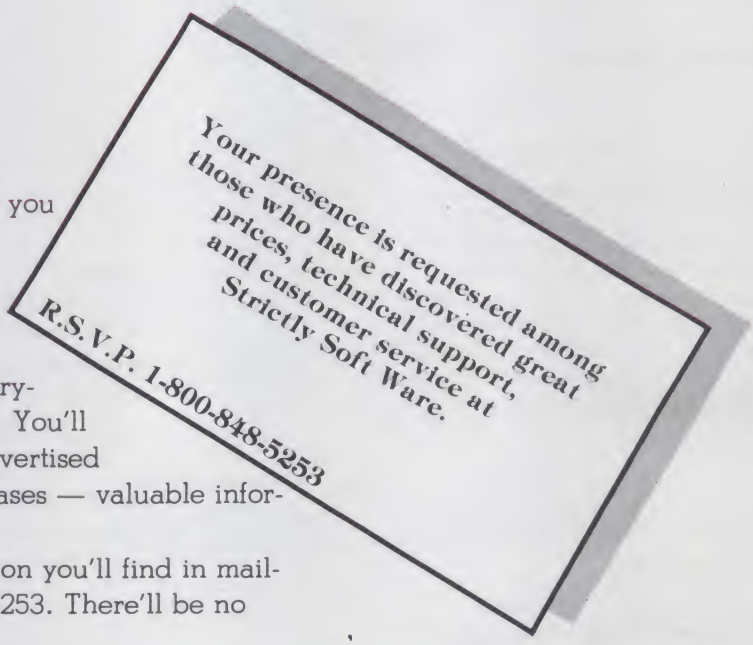

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CIRCLE 342 ON READER SERVICE CARD

In this example, the position of the bullet and monkey are the same sometime between 1.67 and 1.68 seconds. The exact time of impact can be calculated from $t = x/(v_0 \cdot \cos\theta_b)$. In this case, $t = 300/(200 \cdot \cos(26.565°)) = 1.677$ seconds. A display of time broken into thousandths of a second would reveal that we had matched position coordinates. Our test allowing a margin of 1.1 feet caused the program to recognize a hit even though we didn't slice the time as thin as we could have.

Notice that the bullet was still rising when it struck the monkey some 45 feet below the tree branch. A slower initial velocity will produce a more dramatic effect when plotted. Be careful not to reduce the muzzle velocity too much or the bullet won't reach the monkey. Using the values for x and y here, a bullet will go 300 feet only if its muzzle velocity exceeds 109.54 feet/sec.

The range of a projectile can be computed from:

$$r = (2 \cdot v_0^2 \cdot \cos\theta_b \cdot \sin\theta_b)/g = (v_0^2 \cdot \sin 2\theta_b)/g$$

The total flight time $t = (2 \cdot \sin\theta_b \cdot v_0)/g$ is the time the bullet would stay in flight if it didn't strike anything. This is not the same as the value for t offered earlier which is time to reach a certain horizontal distance from start. The latter is total flight time without collision, or time to reach maximum range, the former represents time to strike the monkey.

The reader is encouraged to refine the tests given on lines 350–390 so that printing and later plotting does not continue after all chance of striking the monkey has passed.

Aiming Low

The table below gives the results of running Program 1 while aiming under the monkey, in this case at an angle of only 20 degrees. Many students believe this is the proper strategy for hitting the monkey.

```
INPUT MUZZLE VELOCITY OF BULLET
(TRY 200 TO START)? 200

MONKEY IS ELEVATED AT AN ANGLE OF
26.565052 DEGREES FROM HUNTER

INPUT ANGLE OF ELEVATION FOR FIRING? 20

SPECIFY START TIME, END TIME, INCREMENT
? 1.59,1.64,.01
```

"Now I know why he has all the bananas!"

TABLE 2
AIMING BELOW THE MONKEY (Case 1)

TIME	BULLET (X)	BULLET (Y)	MONKEY (X)	MONKEY (Y)
1.59	298.82225	68.312802	300	109.5504
1.60	300.70163	68.486444	300	109.0400
1.61	302.58102	68.656883	300	108.5264
1.62	304.46040	68.824123	300	108.0096
1.63	306.33978	68.988163	300	107.4896
1.64	308.21917	69.149004	300	106.9664

YOU DID NOT HIT THE MONKEY
IN THE TIME FRAME SCANNED!

Clearly the bullet comes within range of the monkey between 1.59 and 1.60 seconds. However, when it does it is 68.4 feet above the ground and climbing at a time when the monkey is 109.3 feet above the ground and falling. This angle of fire results in the bullet passing 41 feet below the monkey. The results are even more striking when plotted. The trajectories are clearly visible on the screen. I'll show you how to modify the programs to plot points instead of printing tables towards the end of the article.

Aiming High

To completely exhaust case 1 the situation where aim is taken above the monkey must be considered.

```
INPUT MUZZLE VELOCITY OF BULLET
(TRY 200 TO START)? 200

MONKEY IS ELEVATED AT AN ANGLE OF
26.565052 DEGREES FROM HUNTER

INPUT ANGLE OF ELEVATION FOR FIRING? 30

SPECIFY START TIME, END TIME, INCREMENT
? 1.71,1.77,.01
```

TABLE 3
AIMING ABOVE THE MONKEY (Case 1)

TIME	BULLET (X)	BULLET (Y)	MONKEY (X)	MONKEY (Y)
1.71	296.18066	124.21439	300	103.21441
1.72	297.91272	124.66559	300	102.66561
1.73	299.64476	125.11359	300	102.11361
1.74	301.37681	125.55839	300	101.55841
1.75	303.10886	125.99999	300	101.00001
1.76	304.84091	126.43839	300	100.43841
1.77	306.57296	126.87359	300	99.87361

YOU DID NOT HIT THE MONKEY
IN THE TIME FRAME SCANNED!

Here the angle of fire is 30 degrees—well over the monkey's head. As the bullet reaches a range of 300 feet, between 1.73 and 1.74 seconds, it is some 125 feet off the ground and rising but the monkey is only 102 feet off the ground. The bullet is a good 23 feet high!

Case 2

That exhausts case 1. Now let's look at case 2. This is where the hunter and the monkey are the same height above the ground. The hunter is either on a hill some distance, 300 feet here, from the tree or he has climbed a tree of his own.

Here we will consider what happens only for the scenario where we aim directly at the monkey. The equations were developed earlier and are reflected on lines 300–330 of program 2. I've also removed the firing angle inputs for this program. The reader may wish to reinsert them to verify that the aiming situation is the same: ***to hit the monkey, you must aim at him.***

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Mathematical Analysis

A complete analysis of the problem requires consideration of three separate cases. They involve the alternate positions of the hunter relative to the monkey. The hunter can be on the ground below the monkey (case 1); at the same height above the ground as the monkey (case 2); or above the monkey (case 3).

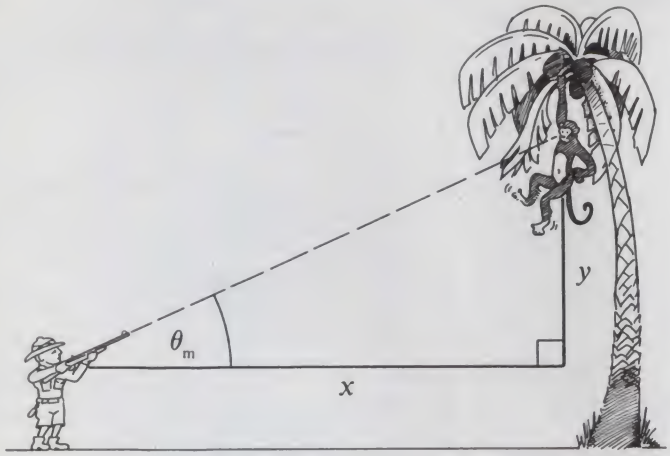

Figure 1

Consider first the case where the hunter stands below and facing the tree from which the monkey hangs. Let the height of the monkey above the ground be y, and the horizontal distance from the monkey to the hunter be x. The angle θ_m—the m represents the monkey—is the angle which the gun barrel must make with the ground in order to take direct aim at the monkey. Some simple geometry tells us that $\tan \theta_m = y/x$. The angle θ_m is just one of many possible aiming angles that the gun barrel could assume. However, it is the only angle which aims directly at the monkey.

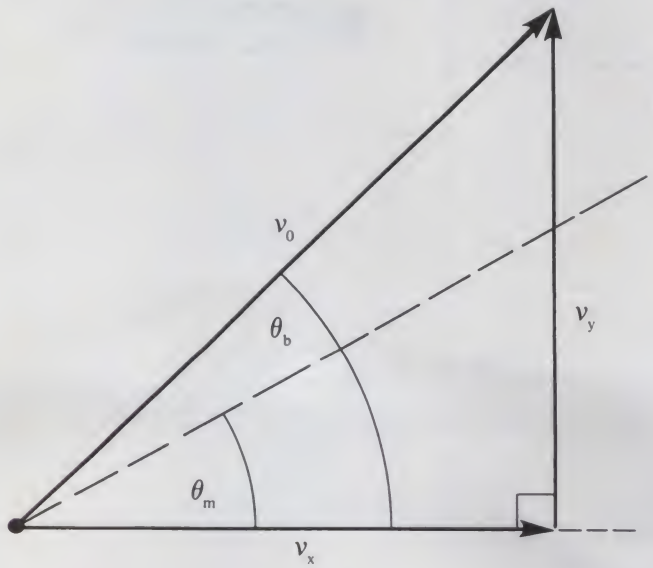

Figure 2

A closer look at the projectile motion at the vertex of the triangle occupied by the hunter and his gun shows that the gun and therefore the bullet could start out at any aiming angle. Call that aiming angle θ_b—here b is for bullet. In the vector diagram of Figure 2, the bold arrows represent vector quantities, possessed of both magnitude (their length) and direction (the way they're pointing). The vector v_0 represents the initial velocity vector for a bullet aimed at an angle θ_b. I should like to prove that only when $\theta_b = \theta_m$ can the bullet and the monkey meet.

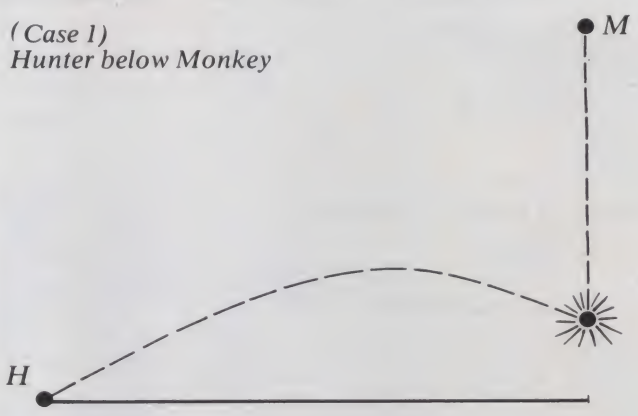

Figure 3

Imagine that the hunter and the monkey are confined to the first quadrant of a cartesian coordinate system. The hunter, located at H, is at the origin (0,0), while the monkey, at M, is at (x,y). Let (x_b,y_b) be the position of the bullet after t seconds and (x_m,y_m) the position of the monkey. The bullet and the monkey meet when $(x_b,y_b) = (x_m,y_m)$ at the same time t. The contention then is that this can only happen when $\theta_b = \theta_m$.

Now, $x_m = x$, since the monkey does not move horizontally. He is always the same horizontal distance, x, from the hunter. Vertically the monkey starts out y feet above the ground. An object which undergoes an acceleration a for a time t moves through a distance $s = .5\,at^2$. Here a is the acceleration due to gravity. Physicists usually use the variable g to represent the acceleration due to gravity. In the English system of measurement g has a value of 32 feet/sec^2. In the metric system it's value is 9.8 meters/sec^2. We will use the value 32 here. So $s = .5\,gt^2$. That's how far the monkey will fall in t seconds. So the altitude y must be reduced by the distance s to get the height of the monkey above the ground at any time t. This means that $y_m = y - .5\,gt^2$.

For the monkey then:

$$x_m = x \qquad y_m = y - .5\,gt^2$$

The Bullet

Now for the bullet. In Figure 2 the initial velocity of the bullet can be broken down into two components. One, v_x, moves the bullet horizontally. The other, v_y, moves the projectile only vertically. These motions are independent. The vertical speed of the bullet does not impact the horizontal motion one iota. Furthermore, the horizontal motion of the bullet does not reduce or increase its rate of rise and fall. Remember we are neglecting the friction of the air. So we can say from Figure 2 that $\tan \theta_b = (v_y/v_x)$. The bullet will move at a velocity of v_x in the horizontal direction. In doing so for t seconds it will travel a distance of $v_x t$. A simple *rate* × *time* relationship. The value of x_b, the abscissa of the bullet, is $x_b = v_x t$.

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CIRCLE 274 ON READER SERVICE CARD

In the vertical plane gravity has the same influence on the bullet as the monkey. The bullet will fall through a distance $s = .5\,gt^2$ in the time t. But here the initial effects of the vertical motion of the bullet must be overcome. After all the bullet is moving upward and gravity cannot slow it down instantly. Vertically the bullet would move through a distance $v_y t$ were it not confined by gravity. Its vertical position then is the latter distance, $v_y t$, reduced by the effects of gravity, $.5\,gt^2$, giving a value for $y_b = v_y t - .5\,gt^2$.

So, in summary, monkey and bullet have:

$$x_m = x \qquad y_m = y - .5\,gt^2$$
$$x_b = v_x t \qquad y_b = v_x t - .5\,gt^2$$

When will $x_m = x_b$ and $y_m = y_b$, i.e., when will the bullet and monkey share the same cartesian position? Clearly from the set of equations above, when $x = v_x t$ and $y = v_y t$. But this means that $(y/x) = (v_y t/v_x t) = (v_y/v_x)$. It is equally clear that $\tan\theta_m = (y/x)$, and that $\tan\theta_b = (v_y/v_x)$ and that, therefore, $\tan\theta_m = \tan\theta_b$. This can only happen when $\theta_m = \theta_b$. Thus proving the only way to hit the monkey is for the angle of aim, θ_b, to match the angle of elevation of the monkey, θ_m.

Case 2

For the second and third case I will give only a diagram and a derivation of the equations of position. The actual mathematical proof follows from case 1 very easily, so I will omit it.

(Case 2)
Hunter same altitude as Monkey

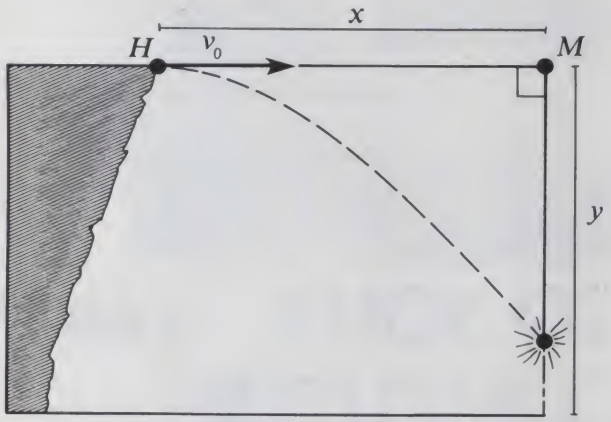

Figure 4

Here $v_0 = v_x$ and $v_y = 0$. The bullet and monkey fall at the same rate. They start from the same elevation and fall in unison. The fact that the bullet is moving horizontally and the monkey is not, has absolutely no bearing on the rate of descent of either.

So, for this case, the coordinates of position for both monkey and bullet are:

$$x_m = x \qquad y_m = y - .5\,gt^2$$
$$x_b = v_0 t \qquad y_b = y - .5\,gt^2$$

Case 3

The third case is a bit more complicated. Here the hunter is located z feet above the monkey who is y feet above the ground himself. So the hunter is $z + y$ feet above the ground.

(Case 3)
Hunter above Monkey

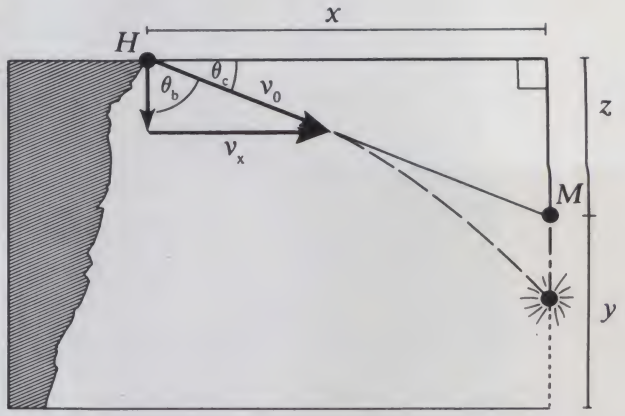

Figure 5

The angle θ_c is the aiming angle or the angle of depression. The vector diagram contains the original angle θ_b, which is the complement of θ_c. Thus, $\theta_b = 90° - \theta_c$. Further, $\tan\theta_c = (z/x)$, so $\theta_c = \tan^{-1}(z/x)$. Also, $\sin\theta_b = (v_x/v_0)$, and $\cos\theta_b = (v_y/v_0)$. This reverses the roll of sine and cosine from the vector diagram for case 1, where $\sin\theta_b = (v_y/v_0)$ and $\cos\theta_b = (v_x/v_0)$. These relationships will be used in the programs below to actually plot the motion of the bullet and the monkey.

In summary, the equations of position for case 3 are as follows:

$$x_m = x \qquad y_m = y - .5\,gt^2$$
$$x_b = v_x t \qquad y_b = (y + z) - v_y t - .5\,gt^2$$

Substituting, $v_x = v_0 \cdot \sin\theta_b$ and $v_y = v_0 \cdot \cos\theta_b$ gives:

$$x_m = x \qquad y_m = y - .5\,gt^2$$
$$x_b = v_0 \cdot \sin\theta_b \cdot t \qquad y_b = (y + z) - v_0 \cdot \cos\theta_b \cdot t - .5\,gt^2$$

The position equations from all three cases can be used to develop tabular evidence to support our contention. Finally slight modifications to each of the three programs, one for each case, allow plotting of the results. This provides more graphic empirical evidence that our mathematical proof is correct.

Tabular Approach

For case 1, I will show the results, not only of aiming directly at the monkey, but also of aiming above and below him. In all three instances it is useful to know how much time it takes for the bullet to reach the monkey. This allows a narrower slice of time to be examined. The analysis of the motion is then that much more detailed.

For case 1, $x_b = v_x t = v_0 \cdot \cos\theta_b \cdot t$ and so $t = x_b/(v_0 \cdot \cos\theta_b)$. The value for t that we wish to find is when the variable $x_b = x_m$, or when the bullet has reached the monkey. I have chosen values of 300 feet for x and 150 feet for y since these values fit nicely into the high resolution mode for the Atari 800 computer and with minor modification the TRS-80 Color Computer. Using the formula for time above, then, it is possible to compute the time in flight given the initial velocity, v_0, the angle of aim, θ_b, and the distance to the monkey, x. So use x for x_b if you want the total flight time, use x_b for itself if you want the time to reach the horizontal distance x_b from start.

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CIRCLE 277 ON READER SERVICE CARD

PROGRAM 2

```
100 PRINT
110 PRINT 'INPUT MUZZLE VELOCITY OF BULLET (TRY 200 TO
    START)';
120 INPUT V
130 X=300       @DISTANCE FROM TREE TO HUNTER
140 Y=150       @HEIGHT OF MONKEY ABOVE GROUND
150 G=32          @ACCELERATION DUE TO GRAVITY OF 32
    FT/SEC12
230 PRINT
240 PRINT 'SPECIFY START TIME, END TIME, INCREMENT'
250 INPUT B,L,N
260 PRINT
270 PRINT 'TIME','BULLET (X)','BULLET (Y)','MONKEY (X)','MONKEY
    (Y)'
280 PRINT
290 FOR T=B TO L STEP N
300 X2=X          @MONKEY'S X-POSITION AT TIME T
310 Y2=Y-(.5*G*T12)   @MONKEY'S Y-POSITION AT TIME T
320 X1=V*T    @BULLET'S X-POSITION AT TIME T
330 Y1=Y2   @BULLET'S Y-POSITION AT TIME T
340 PRINT T,X1,Y1,X2,Y2
350 IF Y2<0 THEN PRINT 'MONKEY LANDED SAFELY (TRY FASTER
    BULLET)'
360 IF Y2<0 THEN PRINT '(OR AIM MORE ACCURATELY!)'
370 IF Y2<0 AND Y1>=0 THEN 440
380 IF Y2>0 AND Y1<0 THEN PRINT 'BULLET HIT GROUND
    ';X-X1;'FT SHORT'
390 IF Y2>0 AND Y1<0 THEN 440
400 IF ABS(X1-X2)<1.1 AND ABS(Y1-Y2)<1.1 THEN PRINT 'YOU
    GOT HIM!'
410 IF ABS(X1-X2)<1.1 AND ABS(Y1-Y2)<1.1 THEN 440
420 NEXT T
430 PRINT 'YOU DID NOT HIT THE MONKEY IN THE TIME FRAME
    SCANNED!'
440 PRINT
450 PRINT 'DO YOU WANT TO TRY ANOTHER SET OF INPUTS
    (YES=0, NO=1)'
460 INPUT W
470 IF W=0 THEN 100
480 END
```

The table below shows a hit at 1.5 seconds, fully 114 feet off the ground.

INPUT MUZZLE VELOCITY OF BULLET
(TRY 200 TO START)? **200**

SPECIFY START TIME, END TIME, INCREMENT
? **1.4,1.6,.01**

TABLE 4
AIMING AT THE MONKEY (Case 2)

TIME	BULLET (X)	BULLET (Y)	MONKEY (X)	MONKEY (Y)
1.40	280	118.6400	300	118.6400
1.41	282	118.1904	300	118.1904
1.42	284	117.7376	300	117.7376
1.43	286	117.2816	300	117.2816
1.44	288	116.8224	300	116.8224
1.45	290	116.3600	300	116.3600
1.46	292	115.8944	300	115.8944
1.47	294	115.4256	300	115.4256
1.48	296	114.9536	300	114.9536
1.49	298	114.4784	300	114.4784
1.50	300	114.0000	300	114.0000

YOU GOT HIM!

Notice that monkey and bullet are always at the same altitude. They fall at the same rate. Remember the bullet was fired from a barrel which was perfectly parallel with the ground. The vertical component of the initial velocity is zero. All the power from the shell propels the bullet horizontally. Gravity alone influences the bullet in the vertical plane.

The situation will develop more slowly if a muzzle velocity below 200 feet/sec is used. However, something must happen before the monkey hits the ground, actually the bullet must be able to travel 300 horizontal feet. In this case both bullet and monkey fall 150 feet in 3.06 seconds. Since $150 = .5\,gt^2$, this means that $t^2 = (150/16)$ and $t = \sqrt{(9.375)}$; in that time the bullet must go 300 feet or more. With a muzzle velocity of 200 feet/sec it can go $200 \times 3.06 = 612$ feet. So a muzzle velocity as slow as $(300/3.06) = 98.05$ feet/sec would be enough to reach the monkey. Of course all these numbers change if the monkey is not 150 feet above the ground and/or 300 feet away.

Case 3

Program 3 below is used for the case when the hunter is above the monkey. An earlier diagram, Figure 5, gave the vertical distance between hunter and monkey as z.

PROGRAM 3

```
100 PRINT
110 PRINT 'INPUT MUZZLE VELOCITY OF BULLET (TRY 200 TO
    START)';
120 INPUT V
130 X=300       @DISTANCE FROM TREE TO HUNTER
140 Y=100       @HEIGHT OF MONKEY ABOVE GROUND
145 Z=50        @HEIGHT OF HUNTER ABOVE MONKEY
150 G=32          @ACCELERATION DUE TO GRAVITY OF 32
    FT/SEC12
160 T2=ATN(Z/X)*57.29578   @ANGLE OF DEPRESSION OF
    MONKEY IN DEGREES
170 PRINT
180 PRINT 'MONKEY IS BELOW AT AN ANGLE OF ';T2;' DEGREES
    FROM HUNTER'
190 PRINT
200 PRINT 'INPUT ANGLE OF DEPRESSION FOR FIRING ';
210 INPUT A
215 A=90-A      @FIND COMPLEMENT FOR ANGLE
220 A1=A/57.29578   @CONVERT TO RADIANS
230 PRINT
240 PRINT 'SPECIFY START TIME, END TIME, INCREMENT'
250 INPUT B,L,N
260 PRINT
270 PRINT 'TIME','BULLET (X)','BULLET (Y)','MONKEY (X)','MONKEY
    (Y)'
280 PRINT
290 FOR T=B TO L STEP N
300 X2=X          @MONKEY'S X-POSITION AT TIME T
310 Y2=Y-(.5*G*T12)   @MONKEY'S Y-POSITION AT TIME T
320 X1=V*SIN(A1)*T    @BULLET'S X-POSITION AT TIME T
330 Y1=(Y+Z)-(V*COS(A1)*T)-(.5*G*T12)   @BULLET'S Y-VALUE
    AT T
340 PRINT T,X1,Y1,X2,Y2
350 IF Y2<0 THEN PRINT 'MONKEY LANDED SAFELY (TRY FASTER
    BULLET)'
360 IF Y2<0 THEN PRINT '(OR AIM MORE ACCURATELY!)'
370 IF Y2<0 AND Y1>=0 THEN 440
380 IF Y2>0 AND Y1<0 THEN PRINT 'BULLET HIT GROUND
    ';X-X1;'FT SHORT'
390 IF Y2>0 AND Y1<0 THEN 440
400 IF ABS(X1-X2)<1.1 AND ABS(Y1-Y2)<1.1 THEN PRINT 'YOU
    GOT HIM!'
410 IF ABS(X1-X2)<1.1 AND ABS(Y1-Y2)<1.1 THEN 440
420 NEXT T
430 PRINT 'YOU DID NOT HIT THE MONKEY IN THE TIME FRAME
    SCANNED!'
440 PRINT
450 PRINT 'DO YOU WANT TO TRY ANOTHER SET OF INPUTS
    (YES=0, NO=1)'
460 INPUT W
470 IF W=0 THEN 100
480 END
```

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By Fred Huntington

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CIRCLE 205 ON READER SERVICE CARD

In the program I've changed the value of Y to 100, and allowed Z to be 50, so that the entire scene will fit into a 160 × 300 pixel graphics layout. This is sufficient for the Atari 800 using graphics mode 8. The TRS-80 Color Computer will require a horizontal reduction to about 250 pixels.

Line 160 reflects the revised formula for computing the aiming angle in degrees. We use Z instead of Y. Line 215 takes the complement of the aiming angle because the vector diagram given in Figure 5 clearly shows that $A = \theta_c$ is not within the vector triangle. $A1$ represents θ_b in radians in all subsequent calculations in the program. Lines 300–330 contain the formulas for case 3 developed earlier.

```
INPUT MUZZLE VELOCITY OF BULLET
(TRY 200 TO START)? 200

MONKEY IS ELEVATED AT AN ANGLE OF
9.4623222 DEGREES FROM HUNTER

INPUT ANGLE OF ELEVATION FOR FIRING? 9.462

SPECIFY START TIME, END TIME, INCREMENT
? 1.5,1.6,.01
```

TABLE 5
AIMING AT MONKEY (Case 3)

TIME	BULLET (X)	BULLET (Y)	MONKEY (X)	MONKEY (Y)
1.50	295.91817	64.680298	300	64
1.51	297.89096	63.869901	300	63.5184
1.52	299.86374	63.056303	300	63.0336

YOU GOT HIM!

The run above shows only the case where we take aim directly at the monkey. The monkey is hit 1.52 seconds or so after firing.

Graphics Modifications

If you have a TRS-80 Color Computer with Extended Color Basic add the following commands to any of the three previous programs. The trajectories of both monkey and bullet will then be visible.

```
130   X = 250
140   Y = 150
252   PMODE 4,1
253   PCLS
254   SCREEN 1,1
255   COLOR 5,7
335   Y1 = ABS(Y1 - 150)
337   Y2 = ABS(150 - Y2)
340   PSET (X1,Y1):PSET (X2,Y2)
350   IF ABS(X1 - X2)<1 AND ABS(Y1 - Y2)<1
      THEN SOUND 100,3
425   FOR U = 1 TO 5000:NEXT U
```

Delete lines 360, 370, 380, 390, 400 and 410. Add your own tests for a hit using the graphics features available on your machine.

Line 130 changes the horizontal distance to 250 feet since the TRS-80 has only 256 × 192 pixels in high resolution graphics mode. Line 252 selects graphics mode 4—highest resolution—and starts on memory page 1. Line 253 clears the screen in graphics mode. Line 254 activates the graphics mode and cancels the text mode. It also selects color set 1. Line 255 establishes the colors.

Lines 335 and 337 are needed because of a quirk in the way most micros label screen locations. The origin, (0,0), is located in the *upper* left corner of the screen because of the order in which the TV raster lines are scanned. To move the origin to the *lower* left and still retain positive coordinate values—as we expect in a first quadrant graph—we must compute the difference between 150 and the point to be plotted. The absolute value is taken to ensure that only positive values are plotted.

Line 340 actually plots the points. Be sure to include the parentheses. Line 350 produces a short beep when the objects collide. Line 425 keeps the graph on the screen for 20 seconds or so.

Atari 800

If you have an Atari 800 the modifications to the first three programs would then go something like this:

```
130   X = 300
254   GRAPHICS 8:COLOR 1
256   SETCOLOR 2,1,14
335   Y1 = ABS(Y1 - 150)
337   Y2 = ABS(150 - Y2)
340   PLOT X1,Y1:PLOT X2,Y2
```

The Atari resolution is 320 × 160 in graphics mode 8, so we set X back to 300 in line 130. Lines 254 and 256 establish the color set and call the high resolution graphics mode with a four line text window at the bottom of the screen. If you establish your own test for a hit delete lines 360–410. Then add some sound effects as I did for the TRS-80. The Atari sound command is a little different. Note that the commands to plot the points, line 340, have no parentheses.

The points may appear faint on your color TV so be prepared to adjust color, tint and/or brightness. The graph appears clearly on a black and white set.

In both micro modifications I have given only the barest essentials required to see the points and experiment with various trajectories and muzzle velocities. Readers are encouraged to embellish these graphs. Here the monkey is just a series of points. He could be made more real, in a lower resolution mode. The time and location parameters could be displayed on the screen or in the text window as the action develops. Maximum height, range and time in flight can easily be computed from the formulas which I have given earlier.

Make Your Own Game

If a friend is allowed to control the monkey's drop, a two player game can be developed. Joystick or paddle could be used to establish aiming points and firing angles. Soon it becomes apparent that if you root for the monkey, you might advise him to stay put. If you assume a smart hunter is always aiming at the monkey, the bullet will drop below the monkey, if he doesn't let go as the bullet is fired. Unless of course, the muzzle velocity is extremely fast. In that case the monkey would be struck only inches from the branch. In fact, the monkey would be struck even if he didn't let go at very high muzzle velocities. Aiming at his chest, for example, might result in a direct hit on his *belly-button*. The bullet will drop only slightly at high muzzle velocities.

Summary

In short, this can be a useful starting point for user written games and programs where missiles and other projectiles are part of the action. The realism of gravitational influences are easy to build, when you understand a little of the physics at work.

Happy Hunting! □

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Creating A Hole In Applesoft Basic

M. J. Parrott

From time to time it can be useful to leave a space within a Basic program to incorporate perhaps a machine code program or a data space. This is also true for a special reason on the Apple II when one wishes to protect the hi-res pages from program text.

The usual way around this particular problem is to load the Basic text above the hi-res pages either by changing the beginning of program pointer ($67,68) before loading it (usually in an EXEC file) or by letting the program relocate itself to above the hi-res page when it RUNs by using a utility such as the &LOMEM: developed by Neil Konzen (Apple Orchard, March 1980, p. 21).

The drawback with loading a program above the hi-res pages is that approximately 6K of memory is left fallow; it can only be used for machine code routines or shape tables. Also the &LOMEN: utility does not work for very long programs because of the way in which it calculates the new link addresses of the relocated text.

It is desirable therefore to be able to load a program at the normal starting location ($801), to continue up to the area of memory to be protected (this is $2000 to $4000 for hi-res page 1 and $2000 to $6000 for hi-res pages 1 and 2 together), to jump over this area of memory and to continue up to the end of program text.

This is actually quite easy to do, and the program listed will allow you to do it without problem. In essence the only work required is to move the latter part of the program and to change the link addresses where required. There are, however, a couple of provisos, but before pointing these out it is probably best to discuss the general construction of an Applesoft Basic program.

When you type a Basic program it is constructed from memory location $801 (2049) upwards. Memory location $800 will contain a zero value. The actual line of Basic you type in is not stored exactly as you type it. If you call the monitor (CALL-155) and type 800L you can examine the start of any program you have previously typed in or LOADed. The first two bytes of the line are the link address. In reverse order, these point to the start of the next line of Basic. Perhaps the best way of demonstrating this is with an example such as the short program:

```
10 PRINT "HELLO"
20 GO TO 10
```

If you type this in, call the monitor and type 800.817, and press RETURN you will see the following:

```
0800- 00 0E 08 0A 00 BA 22 48
0808- 45 4C 4C 4F 22 00 16 08
0810- 14 00 AB 31 30 00 00 00
```

The values 0E,08 are the link addresses for line 10. They point to location $80E where line 20 starts. At this location appear the link addresses for this line, they point to $816 where you will find the values 00,00. This is how Applesoft knows it has reached the end of a program.

Going back to the first line, the next two locations contain the line number expressed as a hexadecimal number stored in two bytes in reverse order, i.e. 0A 00 for the decimal value 10. Next follows the text of the line. The command PRINT appears as a single byte in the tokenized form BA. There then follow seven bytes which spell out HELLO in standard ASCII (with the high bit set low). Next is the end of line token, a zero byte.

The next line has its link addresses, its line number, and the tokenized form of GO TO which is AB, followed by the number of the object line stored as ASCII values. Then come the end of line token (0) and the two zero value link addresses which signify the end of the program.

In general then, any line of Basic is sandwiched between two zero bytes. This is the first proviso on relocating part of the program: the second part must start with a zero byte so that it looks like a normal line of Basic to Applesoft.

The second proviso is that the last line of the first part of a split program must be

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one that does not simply move on to the next line (because it isn't there). In other words, this last line must be either a GO TO or a RETURN.

If these two conditions are met, and the link addresses are adjusted after splitting, then a program will run quite normally as long as the end of program pointer ($AF,BO) is adjusted and from it the pointers to variables, arrays, and strings are also reset.

If the program is SAVEd, however, in its split form, everything will be there on a subsequent LOADing, but the program will only LIST up to the end of the first part, and it will not RUN correctly. The reason is not hard to find. All the link addresses are correct except for those in this last line. Therefore a split program must POKE in the two "wrong" link addresses when it begins to execute.

There is another annoying thing about a split program saved to disk: there is a waste of disk space. In the case of a program split around one hi-res page, 34 sectors are lost, and a massive 68 are lost for two hi-res pages. It is true that this space can be used to keep a hi-res picture for either introducing the program or starting it off, but generally I would rather save the disk space.

Now for some time, because I use many longish programs with big arrays and graphical output, I have been splitting Basic programs around the hi-res pages using two small machine code programs. The first of these two programs listed the link addresses of a Basic program in memory and on choosing a convenient location at which to start the split it gave me the decimal equivalent (for POKEing purposes) and the corresponding line number (so I could change this line to a GOTO the next if necessary).

The second program then actually split the Basic program for me using data that I passed to it so it knew to where to split and from where. I was quite happy with this system although it was a little clumsy to use until I began to worry about the lost disk space, and until friends who were also interested in splitting programs complained about the complicated procedure required.

It suddenly occurred to me one night that Neil Konzen had the right idea when he incorporated his relocating routine within the body of the program itself. Clearly it would be better to let the Basic program be split after LOADing and RUNning, and also it should all be as automatic as possible. Thus was born the &CLEAR...TO... utility.

There are two ways of using the utility. One is to let the Applesoft program listed assemble the machine code program for you in memory and then save it to disk. Then, when used, the machine code program is merely BRUNned from within the Basic program. The second is to incorporate the listed Applesoft program within your own program and CALL the machine code routine after it has been POKEd in.

After the routine is BRUNned or CALLed, the area of memory to be kept clear is merely passed to it as two decimal values. These need not be simple numbers; they can be expressions. For example to clear the area of memory required for two hi-res pages a line of Basic such as

```
1 PRINT CHR$(13)+CHR$(4)"BRUN
CLEARSPLIT":&CLEAR 2*16*256 TO
6*16*256
```

will accomplish the split as long as the binary file CLEARSPLIT is on the disk.

As long as the lower area is cleared first, a second or third area can also be cleared merely by invoking the appropriate &CLEAR..TO.. line. The utility can also be used in the immediate mode as long as it is BRUNned first. Thus, a program can be split and saved in the split form as long as a line of Basic is incorporated to POKE in the two link addresses as explained above. (You will have to determine the exact values after incorporating the line by either going through the memory following the link addresses yourself or by using a small program as described above).

The utility can also be used to relocate completely a program above the hi-res page as in Neil Konzen's &LOMEM: utility but without the worry of losing part of a long program. This is accomplished by using the lines

```
1 PRINT CHR$(13)+CHR$(4)"BRUN
CLEARSPLIT": &CLEAR 1024 TO
16384
2 POKE 104,64 :REM for page one
```

Five points are worth noting when using the &CLEAR..TO.. utility. The first is that it must be used early in a program before any of your variables or strings are defined since it does a CLEAR before returning to the Basic. The second is that it does not protect itself by resetting HIMEM: so it will be overwritten by any string activity. The third is that the line number corresponding to the first line in the latter part will be displayed on the screen. The fourth is that an attempt to set an initial value not within the program will result in an error message, as will the wrong syntax in the line. The fifth is that after splitting, a program cannot be edited.

Hole in Applesoft, continued...

Listing 1. Source code for CLEAR-SPLIT, the program that breaks a Basic program into two pieces.

```
 1 ORG     $7400
 2 ADDRS   EQU  $50
 3 TEMP    EQU  $5E
 4 AMPSND  EQU  $3F5
 5 SYNCHK  EQU  $DEC0
 6 FRMNUM  EQU  $DD67
 7 GETADR  EQU  $E752
 8 STRING  EQU  $ED20
 9 PRGBEG  EQU  $67
10 VARPNT  EQU  $69
11 CURLIN  EQU  $75
12 HIGHDS  EQU  $94
13 HIGHTR  EQU  $96
14 LOWTR   EQU  $9B
15 PRGEND  EQU  $AF
16 FBUFFR  EQU  $100
17 BLTU    EQU  $D393
18 CLEAR   EQU  $D66C
19 ERROR   EQU  $D412
20 **********************
21 *
22 * &CLEAR...TO...
23 *
24 *
25 **********************
26         LDA  #$4C      ;SET UP &-VECTOR
27         STA  AMPSND
28         LDA  #>LOMEM
29         STA  AMPSND+1
30         LDA  #<LOMEM
31         STA  AMPSND+2
32         RTS
33 **********************
34 FROM    DS   2
35 TO     DS   2
36 LOMEM  LDA  #$B0      ;THE CLEAR TOKEN
37         JSR  SYNCHK    ;IS NEXT CHAR CLEAR?
38         JSR  FRMNUM    ;GET ADDRESS FROM WHICH TO SPLIT
39         JSR  GETADR    ;PUT IT IN ADDRS
40         LDA  ADDRS     ;TRANSFER IT TO TEMP STORAGE
41         STA  FROM
42         LDA  ADDRS+1
43         STA  FROM+1
44         LDA  #$C1      ;THE TO TOKEN
45         JSR  SYNCHK    ;IS NEXT CHAR TO
46         JSR  FRMNUM    ;GET ADDRESS TO WHICH TO GO
47         JSR  GETADR    ;PUT IT IN ADDRS
48         LDA  ADDRS
49         STA  TO
50         LDA  ADDRS+1
51         STA  TO+1
52         CLD
53         LDY  #$01      ;CHECK THERE IS A PROGRAM
54         LDA  (PRGBEG),Y ;IN MEMORY
55         BNE  OKAY
56 ERR     JMP  ERROR
57 OKAY    SEC             ;WE HAVE TO KEEP AT LEAST
58         LDA  FROM      ;11 BYTES FOR THE NEW LINE
59         SBC  #$B       ;TO BE CREATED
60         STA  FROM
61         BCS  ADDED
62         DEC  FROM+1
63 ADDED   LDA  PRGBEG    ;SET POINTER TO LINK
64         STA  ADDRS     ;ADDRESSES AND
65         STA  TEMP      ;TEMP STORAGE
66         LDA  PRGBEG+1
67         STA  ADDRS+1
68         STA  TEMP+1    ;TEMP STORAGE
69 LOOP    LDY  #$01       ;SEARCH THROUGH BASIC
70         LDA  (ADDRS),Y ;CHECKING LINK ADDRESSES
71         BEQ  ERR       ;ZERO BYTE IS END OF PROG
72         CMP  FROM+1    ;UP TO FROM YET?
73         BEQ  HIFND     ;GO CHECK LO BYTE
74         BCS  CONT      ;DONT CHANGE HI BYTE
75         STA  TEMP+1    ;TEMP STORAGE
76         DEY
77         LDA  (ADDRS),Y ;GET LO BYTE OF LINK
78 NOTYET  STA  ADDRS
79         STA  TEMP      ;TEMP STORAGE
80         LDA  TEMP+1
81         STA  ADDRS+1   ;RESET LINK POINTER
82         BCC  LOOP
83 HIFND   STA  LOWTR     ;TEMP STORAGE FOR HI BYTE
84         DEY
85         LDA  (ADDRS),Y ;GET LO BYTE
86         CMP  FROM
87         BCS  CONT      ;BIGGER? THEN GO ON
88         TAX             ;TEMP STORAGE FOR LO BYTE
89         LDA  LOWTR     ;GET HI BYTE
90         STA  TEMP+1    ;TEMP STORAGE
91         TXA             ;REGET LO BYTE
92         BCC  NOTYET
93 CONT    SEC
94         LDA  TEMP      ;GET OLD LO BYTE OF LINK
95         SBC  #$01      ;SET POINTER TO 0 BYTE BEFORE THE LINE
96         STA  LOWTR     ;SET UP BLTU POINTER
97         LDA  TEMP+1
98         SBC  #$00
99         STA  LOWTR+1
100        CLC
101        LDA  PRGEND
102        ADC  #$01      ;BLTU WANTS NEXT LOC
103        STA  HIGHTR
104        BCC  CONT2
105        INC  PRGEND+1
106 CONT2  SEC             ;CALC NO OF BYTES
107        SBC  LOWTR     ;TO MOVE
108        STA  FROM      ;AND STORE IT IN FROM
109        LDA  PRGEND+1  ;AND FROM+1
110        STA  HIGHTR+1
111        SBC  LOWTR+1
112        STA  FROM+1
113        CLC
114        LDA  FROM      ;CALC NEW PRGEND
115        ADC  TO        ;AND VECTORS
116        STA  HIGHDS    ;FOR BLTU
117        STA  PRGEND
118        STA  VARPNT
119        TAX
120        LDA  FROM+1
121        ADC  TO+1
122        STA  HIGHDS+1
123        STA  PRGEND+1
124        STA  VARPNT+1
125        TAY             ;FOR BLTU
126        TXA             ;FOR BLTU
127        JSR  BLTU      ;MOVE THE LATTER HALF
128        LDA  CURLIN    ;TEMP STORAGE FOR CURRENT
129        PHA             ;LINE NUMBER
130        LDA  CURLIN+1
131        PHA
132        LDY  #$03
133        LDA  (LOWTR),Y ;GET LINUM TO
134        STA  CURLIN    ;CHANGE IT TO A
135        INY             ;STRING
136        LDA  (LOWTR),Y
137        STA  CURLIN+1
138        JSR  STRING
139        PLA             ;RESTORE CURRENT LINE
140        STA  CURLIN+1  ;NUMBER
141        PLA
142        STA  CURLIN
143        LDY  #$03      ;NOW DECREASE LNUM
144        LDA  (LOWTR),Y ;BY 1 FOR NEW LINE
145        SEC
146        SBC  #$01
147        STA  (LOWTR),Y
148        INY
149        LDA  (LOWTR),Y
150        SBC  #$00
151        STA  (LOWTR),Y
152        LDY  #$05
153        LDA  #$AB      ;THE GOTO TOKEN
154        STA  (LOWTR),Y
155        LDX  #$FF
156 LINE   INX
157        LDA  FBUFFR,X
158        INY
159        STA  (LOWTR),Y
160        CMP  #$00
161        BNE  LINE
162        CLC
163        LDA  LOWTR
164        ADC  #$01      ;ADJUST POINTER TO LINK ADD.
165        STA  LOWTR
166        BCC  LINK
167        INC  LOWTR+1
168 LINK   CLC
169        LDA  #$01      ;NOW CHANGE LINK ADDRESSES
170 LOOP2  ADC  TO
171        LDY  #$00
172        STA  (LOWTR),Y
173        STA  TO
174        PHA             ;TEMP STORAGE
175        BCC  CONT5
176        INC  TO+1
177 CONT5  LDA  TO+1
178        INY
179        STA  (LOWTR),Y
180        STA  LOWTR+1
181        PLA             ;RESET LOWTR TO NEXT
182        STA  LOWTR
183        LDA  (LOWTR),Y
184        BEQ  DONE      ;ZERO BYTE IS END OF PROG
185        LDY  #$04       ;SKIP LNUMS
186 LOOP1  INY
187        LDA  (LOWTR),Y
188        CMP  #$00      ;LOOK FOR EOL
189        BNE  LOOP1
190        INY
191        TYA
192        CLC
193        BCC  LOOP2
194 DONE   JMP  CLEAR     ;LET APPLESOFT DO THE REST
```

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Listing 3. These Hexadecimal codes can be entered into memory from the system monitor. The CLEARSPLIT object code is shown.

```
*9400.9550

9400- A9 4C 8D F5 03 A9 14 8D
9408- F6 03 A9 94 8D F7 03 60
9410- 00 00 00 00 A9 BD 20 C0
9418- DE 20 67 DD 20 52 E7 A5
9420- 50 8D 10 94 A5 51 8D 11
9428- 94 A9 C1 20 C0 DE 20 67
9430- DD 20 52 E7 A5 50 8D 12
9438- 94 A5 51 8D 13 94 D8 A0
9440- 01 B1 67 D0 03 4C 12 D4
9448- 38 AD 10 94 E9 0B 8D 10
9450- 94 B0 03 CE 11 94 A5 67
9458- 85 50 85 5E A5 68 85 51
9460- 85 5F A0 01 B1 50 F0 DD
9468- CD 11 94 F0 11 B0 21 85
9470- 5F 88 B1 50 85 50 85 5E
9478- A5 5F 85 51 90 E4 85 9B
9480- 88 B1 50 CD 10 94 B0 08
9488- AA A5 9B 85 5F 8A 90 E4
9490- 38 A5 5E E9 01 85 9B A5
9498- 5F E9 00 85 9C 18 A5 AF
94A0- 69 01 85 96 90 02 E6 B0
94A8- 38 E5 9B 8D 10 94 A5 B0
94B0- 85 97 E5 9C 8D 11 94 18
94B8- AD 10 94 6D 12 94 85 94
94C0- 85 AF 85 69 AA AD 11 94
94C8- 6D 13 94 85 95 85 B0 85
94D0- 6A A8 8A 20 93 D3 A5 75
94D8- 48 A5 76 48 A0 03 B1 9B
94E0- 85 75 C8 B1 9B 85 76 20
94E8- 20 ED 68 85 76 68 85 75
94F0- A0 03 B1 9B 38 E9 01 91
94F8- 9B C8 B1 9B E9 00 91 9B
9500- A0 05 A9 AB 91 9B A2 FF
9508- E8 BD 00 01 C8 91 9B C9
9510- 00 D0 F5 18 A5 9B 69 01
9518- 85 9B 90 02 E6 9C 18 A9
9520- 01 6D 12 94 A0 00 91 9B
9528- 8D 12 94 48 90 03 EE 13
9530- 94 AD 13 94 C8 91 9B 85
9538- 9C 68 85 9B B1 9B F0 0E
9540- A0 04 C8 B1 9B C9 00 D0
9548- F9 C8 98 18 90 D3 4C 6C
9550- D6
```

Listing 2. Basic program that pokes the object code of CLEARSPLIT into the highest available RAM locations.

```
0  REM

'CLEARSPLIT' IS ASSEMBLED BY
THIS APPLESOFT PROGRAM

10  TEXT : HOME
20  PRINT "THE MACHINE CODE PROGRAM 'CLEARSPLIT'"
30  PRINT "IS NOW BEING ASSEMBLED UNDER HIMEM:"
40  REM

LOOK AT MACHINE'S HIMEM AND
CALCULATE STARTING LOCATION FOR 'CLEARSPLIT'
(I.E. $200 BELOW HIMEM)

50 P =  PEEK (116) - 2
60 HI =  PEEK (115) + 256 * P
70  FOR I = HI TO HI + 336
80  READ V: POKE I,V: NEXT
90  REM

NOW DATA HAS BEEN ASSEMBLED FOR
A 48K MACHINE.  IF YOURS IS
ALSO 48K, LINES 100 TO 140
INCLUSIVELY MAY BE DELETED

100  IF P = 148 THEN  GOTO 150
110  FOR I = HI TO HI + 336
120  IF  PEEK (I) < > 148 THEN  GOTO 140
130  POKE I,P
140  NEXT
150  PRINT : PRINT : PRINT : PRINT "INSERT YOUR DESTINATION DISC"
160  PRINT "AND PRESS RETURN TO SAVE IT"
170  GET T$: IF  ASC (T$) < > 13 THEN 170
180  PRINT  CHR$ (13) +  CHR$ (4)"BSAVE CLEARSPLIT,A"HI",L337"
190  REM

THE DATA FOLLOWS

200  DATA 169,76,141,245,3,169,20,141,246,3,169,148,141,247,3,96,0,0,0,0,169,189,32,192,222,32,103,2
21,32,82,231,165,80,141,16,148,165,81,141,17,148,169,193,32,192,222,32,103,221,32,82
210  DATA 231,165,80,141,18,148,165,81,141,19,148,216,160,1,177,103,208,3,76,18,212,56,173,16,148,23
3,11,141,16,148,176,3,206,17,148,165,103,133,80,133,94,165,104,133,81,133,95,160,1,177
220  DATA 80,240,221,205,17,148,240,17,176,33,133,95,136,177,80,133,80,133,94,165,95,133,81,144,228,
133,155,136,177,80,205,16,148,176,8,170,165,155,133,95,138,144,228,56,165,94,233,1,133,155
230  DATA 165,95,233,0,133,156,24,165,175,105,1,133,150,144,2,230,176,56,229,155,141,16,148,165,176,
133,151,229,156,141,17,148,24,173,16,148,109,18,148,133,148,133,175,133,105,170,173,17,148,109
240  DATA 19,148,133,149,133,176,133,106,168,138,32,147,211,165,117,72,165,118,72,160,3,177,155,133,
117,200,177,155,133,118,32,32,237,104,133,118,104,133,117,160,3,177,155,56,233,1,145,155,200,177
250  DATA 155,233,0,145,155,160,5,169,171,145,155,162,255,232,189,0,1,200,145,155,201,0,208,245,24,1
65,155,105,1,133,155,144,2,230,156,24,169,1,109,18,148,160,0,145,155,141,18,148,72,144
260  DATA 3,238,19,148,173,19,148,200,145,155,133,156,104,133,155,177,155,240,14,160,4,200,177,155,2
01,0,208,249,200,152,24,144,211,76,108,214
```

There are three ways around this last problem. In the first you must develop the program exclusively above the hi-res pages by changing the start of program pointers and using smaller arrays until *you are* convinced it is perfect. Then add the &CLEAR..TO.. line.

In the second you must keep on disk a version of the program which incorporates any changes you make but which is SAVEd before RUNning. It is this version which is edited. In the third you must use another program which will close up a split program. This is also listed and is called CLOSESPLIT. It is very simple to use. To edit a split program either BRUN CLOSESPLIT or if it is already in memory just CALL 768.

If after splitting a program you LIST it you will notice that CLEARSPLIT has introduced a line of Basic which is a GO TO. CLOSESPLIT will remove this, recombine the program, reset the end of program pointer, and do a CLEAR before returning you to Basic.

I have presented both programs both as Applesoft programs and as original source listings. Both of the Applesoft programs will assemble the appropriate machine code programs in RAM and will then save them to the required destination disk. CLOSESPLIT resides at $300, so the relevant Applesoft program will merely form it and SAVE it.

CLEARSPLIT, however, was originally assembled at $9400 for a 48K machine with DOS. So the relevant Applesoft program has been written so that it will determine the size of memory available (from the HIMEM: pointer at $73,74) for any machine and then assemble the program as appropriate.

Tape users can easily modify these two to their advantage and use CLEARSPLIT in the immediate mode. By incorporating the program within their own programs they can use it in the deferred mode. If you have difficulties with these programs I would very much like details of the problem so I can try to improve both of them. □

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```
1          ORG  $300
2  CLS     EQU  $FC58
3  ERR     EQU  $D412
4  CLEAR   EQU  $D66C
5  DOS     EQU  $3D0
6  TO      EQU  $00
7  TEMP    EQU  $50
8  INDEX   EQU  $5E
9  PRGBEG  EQU  $67
10 ADDRS   EQU  $9B
11 PRGEND  EQU  $AF
12 **********************
13 *
14 * CLOSESPLIT
15 *
16 **********************
17         JSR  CLS       ;HOME
18         LDA  PRGBEG    ;ST INDEX TO POINT AT PROGRAM
19         STA  INDEX
20         LDA  PRGBEG+1
21         STA  INDEX+1
22         SEC
23 LOOP1   LDY  #$01      ;GET HI BYTE OF LINK ADDRESS
24         LDA  (INDEX),Y
25         BEQ  ERROR     ;ZERO BYTE IS END OF PROG
26         STA  TEMP+1    ;TEMP STORAGE
27         SBC  INDEX+1   ;WHAT'S THE DIFFERENCE
28         CMP  #$01
29         BEQ  CONT      ;IF 0 OR 1 THEN NOT YET SPLIT
30         BCS  FOUND     ;IF >1 THEN FOUND SPLIT
31 CONT    DEY            ;LOOK AT LOW BYTE
32         LDA  (INDEX),Y ;GET LO BYTE OF LINK
33         STA  INDEX     ;& UPDATE INDEX
34         LDA  TEMP+1    ;REGET HI BYTE
35         STA  INDEX+1
36         SEC            ;ALWAYS GO BACK & SET FOR SBC
37         BCS  LOOP1     ;& GO BACK
38 ERROR   JMP  ERR
39 FOUND   LDA  INDEX     ;END OF THE FIRST HALF
40         STA  TO
41         LDA  INDEX+1
42         STA  TO+1
43         LDA  (INDEX),Y ;GET START OF 2ND HALF
44         STA  ADDRS+1
45         DEY
46         LDA  (INDEX),Y
47         STA  ADDRS
48         SEC            ;CALC LENGTH OF PART TO MOVE
49         LDA  PRGEND
50         SBC  (INDEX),Y
51         STA  TEMP      ;STORE LO BYTE
52         LDA  PRGEND+1
53         INY
54         SBC  (INDEX),Y
55         TAX            ;HI BYTE INTO X
56         LDY  #$00
57 LOOP2   LDA  (ADDRS),Y ;MOVE TOP HALF
58         STA  (INDEX),Y
59         DEY
60         BNE  LOOP2
61         INC  INDEX+1   ;UPDATE POINTERS
62         INC  ADDRS+1
63         DEX
64         BMI  LOOP4
65         BNE  LOOP2     ;GO BACK FOR MORE
66         LDY  TEMP
67         BNE  LOOP2
68 LOOP4   INY            ;RESET IT TO 1
69         LDA  (TO),Y    ;CHANGE LINK ADDRESSES
70         BEQ  END       ;IF ZERO FOUND IT IS END OF PROG
71         INY
72         INY
73 LOOP3   INY            ;SKIP THE LINE NUMBERS
74         LDA  (TO),Y    ;FIND END OF LINE TOKEN
75         BNE  LOOP3
76         INY
77         CLC
78         TYA
79         ADC  TO        ;COMPUTE NEW LINK ADDRESS
80         LDY  #$00
81         STA  (TO),Y    ;AND UPDATE POINTER
82         STA  TEMP      ;TEMP STORAGE
83         LDA  TO+1
84         ADC  #$00
85         INY
86         STA  (TO),Y
87         STA  TO+1
88         LDA  TEMP
89         STA  TO
90         SEC
91         BCS  LOOP4
92 END     CLC
93         LDA  TO        ;TO NOW POINTS TO END OF PROG
94         ADC  #$03
95         STA  PRGEND    ;SO UPDATE PRGEND
96         LDA  TO+1
97         ADC  #$00
98         STA  PRGEND+1
99         JSR  CLEAR     ;LET APPLESOFT DO THE REST
100        JMP  DOS
```

Listing 4. Source code of CLOSESPLIT, the program that reunites the two sections of a split Basic program.

Listing 5. Basic program that installs CLOSESPLIT object code into RAM.

```
9  REM

DATA FOR THE MACHINE CODE PROGRAM 'CLOSESPLIT'

10  DATA 32,88,252,165,103,133,94,165,104,133,95,56,160,1,177,94,240,22,133,81,229,95,201,1,240,2,17
6,15,136,177,94,133,94,165,81,133,95,56,176,228,76,18,212,165,94,133,0,165,95,133,1
20  DATA 177,94,133,156,136,177,94,133,155,56,165,175,241,94,133,80,165,176,200,241,94,170,160,0,177
,155,145,94,136,208,249,230,95,230,156,202,48,6,208,240,164,80,208,236,200,177,0,240,34,230
30  DATA 200,200,177,0,208,251,200,24,152,101,0,160,0,145,0,133,80,165,1,105,0,200,145,0,133,1,165,8
0,133,0,56,176,217,24,165,0,105,3,133,175,165,1,105,0,133,176,32,108,214,76
39  REM

THE  PROGRAM BEGINS HERE
BY BEING POKED IN

40  DATA 208,3
50  TEXT : HOME
60  PRINT "THE MACHINE CODE PROGRAM 'CLOSESPLIT'"
70  PRINT "IS NOW BEING ASSEMBLED AT $300 (768)"
80  FOR I = 768 TO 768 + 152: READ J: POKE I,J: NEXT
90  VTAB 10: PRINT "INSERT YOUR DESTINATION DISC"
99  REM

NOW  SAVE IT TO DISC

100  PRINT "WHEN READY PRESS <RETURN>"
110  GET T$: IF  ASC (T$) <  > 13 THEN 110
120  PRINT  CHR$ (13) +  CHR$ (4)"BSAVE CLOSESPLIT,A768,L153"
```

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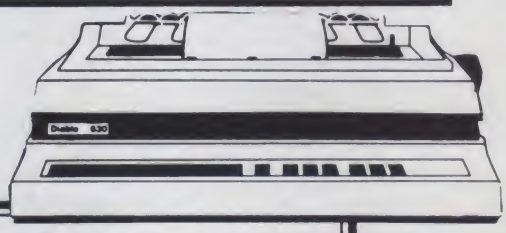

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Keeping Track of Variable Names in an Applesoft Program

Lawrence G. McMillan

When writing a large program in Applesoft, it often becomes difficult to keep track of the variable names used. This is true mostly because Applesoft only recognizes the first two characters of each variable name. While names of any length are allowable, only the first two characters determine uniqueness.

This means you can't, for example, use MAX0 and MAX1 for two variables representing the maxima of two sequences of numbers. You might therefore use M0 and M1, but then what do you use when you want to represent two minima for the same sequences? MIN0 and MIN1 are out, and you've already used M0 and M1, so you make up something else. After several hundred lines of code (especially if you don't own a printer), it can be confusing trying to remember what you have used and what you haven't.

Fortunately, the Applesoft Manual provides the addresses to the variable names in the variable table. The accompanying Applesoft utility routine accesses those locations and prints the variable names, also indicating whether the variable type is a real, integer, or string variable.

Simple Variables

Simple variables in Applesoft are stored consecutively, beginning at the address stored in locations 105 and 106 in memory. This is true for both ROM and cassette Applesoft. The actual location is determined as LOC = 256 * PEEK(106) + PEEK(105). This location also happens to be LOMEM for an Applesoft program.

Each simple variable takes up seven bytes of storage. The first two bytes are the character name, and the other five bytes represent the value of the variable. With only two bytes reserved for the variable name, you can see why Applesoft only recognizes the first two characters of a variable name when determining uniqueness.

The variable type (floating point, integer, or string) is determined by the manner in which the two-character name is stored.

The variable type (floating point, integer, or string) is determined by the manner in which the two-character name is stored. Most ASCII characters can be represented internally by the Apple in two ways—as a decimal number less than 128 or as a decimal number greater than 127. The "positive" representation is one that is less than 128 (the high-order bit is off). The "negative" representation is the one that is greater than 127 (the high-order bit is on). If the decimal representations of both characters in the variable name are "positive" (less than 128), then the variable is a real, or floating point, value. If both decimal representations are "negative" (greater than 127), then the variable is an integer. Otherwise, it is a string variable.

As an example, the integer variable name II% would be stored as 201,201 in the two bytes representing the character name. The % sign is not actually a part of the variable name, but is used by Applesoft as a special symbol to indicate that the value stored in the variable II is to be treated as an integer value. In this case, the character "I" is represented as 201—its negative representation. However, the character "I" may also be represented as decimal 73. This would be its positive representation. Hence, the real variable name, II, would be represented as 73,73. That is, both representations being positive indicate a real value.

Finally, II could also be a string variable (II$). If this were the case, then it would have a decimal representation of 73,201—the first representation is positive and the second is negative. Appendix K in the Applesoft Manual shows the various representations of each ASCII character, both positive and negative.

Since each simple variable takes exactly seven bytes of storage, it is a relatively easy matter to step through the variable table extracting the names and identifying the variable types. In the accompanying listing, the starting address of the variable table is obtained in line 10. Lines 40 to 80 do the work of identifying the variable type and then incrementing the address

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by 7 to get to the next name. In this utility routine, only five names are printed at a time. To continue, the program must type "C" to continue the listing. The programmer will recognize the end of his simple variable table when strange characters or blanks begin appearing as variable names. Once this happens, he may then type an "A" to begin scanning the array variables. Lines 120 to 140 in the listing handle these things.

Array Variables

The pointer to the beginning of the array variables is stored by Applesoft in locations 107 and 108. Again, the address where these variables begin is determined as LOC = 256 * PEEK(108) + PEEK(107). The routine determines this at line 150 and sets a flag at line 160. This flag indicates to the utility that array variables, not simple variables, are now being scanned.

As was the case with simple variables, the first two bytes of storage of an array variable are the decimal representations of characters in the variable name. The same recognition rules apply—a real has two positive representations, an integer has two negatives, and a string has one of each. However, the way in which the actual values of the array variable are stored differs somewhat from the way in which the simple variable value was stored. Each simple variable used five additional bytes of storage to represent its value. However, since arrays may be of varying length, the amount of storage used is not fixed. Rather, the third and fourth bytes of storage for the variable are used to denote how many bytes of storage are necessary for the storage of this entire array.

Listing 1.

```
 10 X = 265 * PEEK (106) + PEEK (105):REM GET SIMPLE VARIABLES
                                        STARTING POINT
 20 PRINT X; "=STARTING ADDR FOR SIMPLE VRBLS"
 30 L = 0:              REM FLAG DENOTING SIMPLE OR ARRAY VRBLS
 40 FOR I = 1 TO 5
 50 PRINT CHR$ (PEEK (X)); CHR$ (PEEK (X + 1));
 60 IF PEEK (X) > 127 AND PEEK (X+1) > 127 THEN PRINT "%";
 70 IF PEEK (X) < 128 AND PEEK (X+1) > 127 THEN PRINT "$";
 80 IF L = 0 THEN X = X + 7 : REM ADD 7 FOR SIMPLE VRBLS
 90 IF L = 1 THEN X = X + PEEK (X + 2) + 256 * PEEK (X + 3)
100 PRINT
110 NEXT I
120 INPUT "C TO CONTINUE, A FOR ARRAYS"; LTR$
130 IF LTR$ = "C" THEN 40
140 IF LTR$ <> "A" THEN 120
150 X = 256 * PEEK(108) + PEEK (107): REM GET START OF ARRAY LIST
160 L = 1 : REM SET FLAG FOR ARRAY VRBLS NOW
170 GO TO 40
```

One can then determine the address at which the next array begins by adding this length to the beginning address of the array variable at which you are currently looking. That is,

start of next array variable = 256*PEEK (4th byte) + PEEK(3rd byte) + starting address of this array.

This is done in line 90 of the accompanying listing.

The routine has no end statement, so the user can hit CTRL C to terminate when he has reached the end of his array table.

Running the Routine

To run this routine, first store it separately on disk. Then use RENUMBER and its MERGE facility to place the routine just before the END statement in your program. Then, at the end of the next execution of your programs, you will get a list of your variable names. For those not familiar with RENUMBER:

1) RUN RENUMBER

2) LOAD or type in this routine and renumber its line numbers to be just before the END statements of your main program's END statement

3) &H to put the routine in the HOLD area

4) LOAD your main program

5) &M to merge the two (program and routine) together

6) RUN the main program

Summary

To summarize, writers of lengthy Applesoft programs may lose track of their variable names because of the two-character representation. The accompanying routine steps through the simple and array variable tables, identifying the variable type. It is a handy way of keeping track of the variable names before some serious and time-consuming bug crops up because a variable name was inadvertently reused. □

Output Au Naturel

Daniel H. Lowenstein

"What is this," you say, "a Fortran article in Creative Computing*?" Yes. For two reasons.*

First, many readers have systems with Fortran and to use material in Creative *they generally must convert from Basic. They occasionally grumble, but usually not. They generally are a resourceful lot. Well this is for them. No conversion necessary.*

Second, this is a useful technique and readers with Basic speaking systems should have little trouble understanding the well-commented listing.—DHA

If you have been writing programs which involve word processing, you have undoubtedly run across the problem of formatting your output so that it reads naturally. That is, text is constructed so that words are properly spaced, punctuation is correct, and the text has normal sentence and paragraph structure.

In my work involving computer-aided medical diagnosis, I have faced this problem as well. We who are familiar with the ins and outs of computers do not find the typical tabular output of our machines offensive. However, physicians and other health-care personnel expect a report to read as though it were written with standard rules of text formatting.

Not having a sophisticated text editor onboard my mini to handle this task, I developed a technique that interprets a diagnostic algorithm and outputs a paragraph summary which reads as though a physician wrote it.

The approach I use is so straightforward, flexible, and reasonable in storage requirements, that some of you in the micro world might be interested in trying it out.

The only prerequisites are a machine which has enough memory to handle the library of phrases from which you construct the output (plus some memory for the algorithm to fit them together), and a language which can concatenate and split strings (e.g. Fortran 77).

I will use the game "Adventure Caverns" in my examples cited below. This game challenges the player to find his way to a treasure by specifying the directions and implements needed for travel through a mythical land. After each user response, the computer summarizes the travel thus far and prompts for more decisions.

The fancier versions of this game format the output in paragraphs and become interactive fairy tales. The basic approach I describe, however, can be applied to any task which involves formulating text based upon an algorithm and formatting it naturally, e.g. business reports, weather summaries, and astrology impressions.

The strategy is outlined in Figure 1. The data resource would include the information specifying the parameters of the game as well as the prior responses of the user. The algorithm specifies the rules and keeps track of the advancement of the player.

The *phrase array* is a lexicon of all the possible phrases which might be used in the status reports of a game. Each separate phrase constitutes a single element of the array. The array is defined as type *character*.

I chose a string length of 30 in my applications, though this could be modified to a more convenient length depending upon your own needs. The ordering of phrases within the phrase array may be arbitrary, though I found that grouping them according to common usage facilitated code formulation and changes.

Now, using the algorithm, a second array is defined. Contained within this *report array* are the element locations of the phrases to be used in a particular report. As an example, let us suppose that the player is asked in what direction to proceed. The response is "north."

The algorithm, which is keeping track of the player's location, specifies that this would head the player into the Misty Mountains. Therefore, an element in the report array might be assigned the integer value 31, corresponding to the thirty-first element in the phrase array: "You are now heading." The next element of the report array would be filled with the integer value 10, corresponding to the phrase 'north."

As the figure shows, the subsequent elements in the report array would be filled with the phrases which comprise the desired sentence. Once fully constructed, the report array becomes a source for defining the sequence of phrases to be used in a particular output.

Next, a *formatter* subroutine is called.

The Fortran 77 code is found in Listing 1. By accessing the information within both the report array and phrase array, the program concatenates individual phrases into lines of text. Line length are defined according to the desired format of the output record.

In the event a phrase exceeds the extent of the line, the formatter searches for blanks within the phrase, places a shorter part of the phrase in the line if possible, and places the remainder of the string in the following line of text. If the formatter encounters a null value in an element of the report array, it merely ignores that element. Therefore, it is not necessary to have every element of the report array filled with a value. I have found this to be

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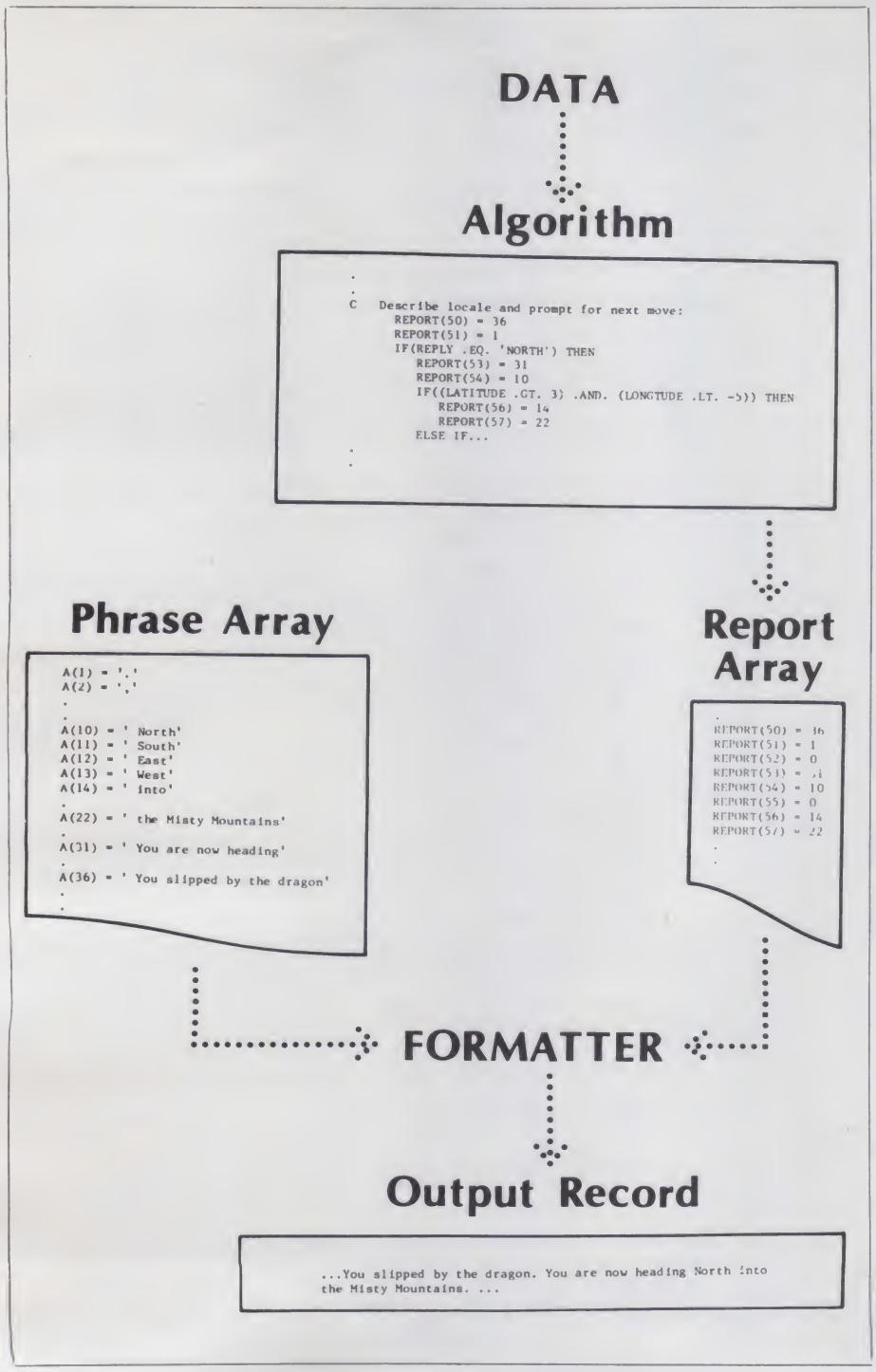

Figure 1.

a great aid in altering text.

By the time the formatter subroutine passes back to the main program, the phrases have been arranged into lines and can be written to the desired output device. The sample sentence constructed above might be at the end of a status report reading as follows:

...You slipped by the dragon. You are now heading north into the Misty Mountains. There is a clearing ahead. In what direction do you wish to proceed?

You might note that the subroutine checks for punctuation marks to ensure that they do not become the first character in a new line. Also, in order to create a new paragraph, the algorithm merely has to place the integer which specifies a string of five blanks into the report array.

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Output, continued...

As you can see, the applications of this approach for natural language formatting are limited primarily by the memory allocation on your machine. A valuable subroutine which could improve the efficiency of the code would be one which packs the phrases in the phrase array. In this way, the default length of 30 for the array would not be placing unneeded blanks into memory. In addition, I have yet to explore the possibility of splitting words into syllables. □

Listing 1.

```
      SUBROUTINE MINIFORM(A,B,LINE)

C*************************************************************
C
C              Created by D. H. Lowenstein
C
C    The lexicon of phrases is passed to this subroutine and
C  defined as the array "A." Also passed is the report array, which
C  specifies the make-up of the text, defined as array "B." The
C  formatted text will be passed back to the main program in the
C  array "LINE."
C
C*************************************************************
       CHARACTER*78 LINE(12), A(100)*30
       INTEGER B(100),LINELEN,NPHRASE,WORDSLEN,LINEUSED
C
C     Definitions of Local Variables:
C         LINELEN = Length of line of text. (Must equal that
C                   specified in the above CHARACTER statement!!)
C         NPHRASES = Number of phrases being used (Highest non-blank
C                   element of A)
C         WORDSLEN = Length of phrase
C         PHRASLEN = Maximum length of phrases (dimension of A!!)
C         LINEUSED = Portion of line filled
C
C    Initialize variables:
C
         LINELEN=78
         NPHRASES=100
         PHRASLEN=30
         LINEUSED=0
         K=1
C
C
         DO 1000 I=1,NPHRASES
C
C    If an element of the report array is null, loop through to
C    the next element.
C
            IF(B(I) .EQ. 0) GO TO 1000
C
C    Otherwise, determine the length of trailing blanks and hence the
C    "true" length of the phrase:
C
            DO 100 J=PHRASLEN,1,-1
               IF( A(B(I))(J:J) .NE. ' ') THEN
                  WORDSLEN = J
                  GO TO 200
               END IF
100         CONTINUE
C
C    If there is space in the present line to place the phrase,
C    do so.  The last character space in each line is
C    reserved for placement of punctuation (i.e. to avoid placing
C    a period or comma at the beginning of a line.)
C
200         IF( (LINELEN - LINEUSED) .GT. WORDSLEN) THEN
               LINE(K) = LINE(K)(1:LINEUSED)//A(B(I))
               LINEUSED = LINEUSED + WORDSLEN
               GO TO 1000
            ELSE
C
C    If the full phrase does not fit, check to see whether a
C    shorter part can be placed in the present line and the
C    remainder into the following line:
C
            DO 300 N=WORDSLEN,1,-1
               IF(A(B(I))(N:N) .EQ. ' ' .AND. (LINELEN - LINEUSED)
     1         .GT. N) THEN
                  LINE(K) = LINE(K)(1:LINEUSED)//A(B(I))(1:N)
                  LINE(K+1) = A(B(I))(N+1:WORDSLEN)
                  K=K+1
                  LINEUSED=WORDSLEN - N
                  GO TO 1000
```

Listing 1, continued...

```
75                    END IF
76      300         CONTINUE
77                  END IF
78      C       If the phrase to be inserted is a punctuation character
79      C       and there is only one space remaining in the line, insert the
80      C       character.  The code assumes that all punctuation
81      C       marks are listed within the first five elements of the
82      C       phrase array.
83      C
84                  IF((LINELEN - LINEUSED .EQ. WORDSLEN) .AND. (B(I) .LE.
85            1     5)) THEN
86                     LINE(K) = LINE(K)(1:LINEUSED)//A(B(I))
87                  ELSE
88      C
89      C       Otherwise, place the phrase into the following line:
90      C
91                     LINE(K+1) = A(B(I))
92                     LINEUSED = WORDSLEN
93                     K=K+1
94                  END IF
95      1000     CONTINUE
96      C
97      C
98      C       For appropriate spacing of words, phrases (other than
99      C       punctuation) in the phrase array have a leading blank.
100     C       In order to rid text lines of first position blanks, the
101     C       following is carried out prior to RETURN...
102     C
103               DO 2000 K=1,12
104                  IF(LINE(K)(1:1) .EQ. ' ') LINE(K) = LINE(K)(2:78)//' '
105     2000     CONTINUE
106              RETURN
107              END
108     C
109     C*****************************************************************
```


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A Scrolling Routine For CBM/PET Output Listings

Alfred J. Bruey

What do you do if you write a program with 100 lines of output and you don't have a printer? There are three things you can do:

1. Take a speedreading course so you can read the text as it scrolls past on the screen.

2. Run the program. When what you want to see appears on the screen, press STOP. Then type CONT when you are ready to continue with the listing.

3. Put a routine in your Basic program so that it will print the first, say, 20 lines and then stop with the message PRESS RETURN TO CONTINUE. When you are done examining the first 20 lines, you press RETURN and the next 20 lines are displayed on the screen.

All three of these methods have a major shortcoming: once the output has gone off the screen, you can't recall it unless you run the program again. The third method also has a disadvantage in that there is no way to see, for example, lines 10 to 25 on the screen at the same time—lines 1 to 20 fill the screen, then lines 21 to 40, etc.

The program described here provides a simple Basic output scrolling routine. With this routine added to your program, you can scroll up or down either one line or one page (20 lines) at a time, or you can scroll to the top or bottom of the listing. Each of these actions requires only one keystroke.

There is one limitation: All data to be output to the screen must be loaded into an array. After the output has been collected in this array, you branch to a subroutine which handles all the scrolling functions mentioned above.

The print routine given here is an example of the use of the scrolling routine. You can customize it to suit your own purposes. I shall try to explain the coding well enough so that you can extract the parts that you need.

The print subroutine works as follows:

1. We'll assume in this example that the data which we will output will be in array P(I). This array will be dimensioned 100. Any array can be used, and it may be two-dimensional. The first part of the coding is a routine to load data into P(I). So that this example will be easy to follow, I have set P(I)=I.

2. The first thing I do in the print subroutine is to list the first 20 items in P(I). Then the scrolling routine will be activated.

3. The scrolling routine will react to the following keys (note that it will not be necessary to press RETURN since the GET key is used for the scrolling commands).

- U Scroll up 20 lines
- D Scroll down 20 lines
- / Scroll up one line
- * Scroll down one line
- L List last 20 lines in file
- F List first 20 lines in file
- R Return to main program

Enter the program shown in Listing 1. When you RUN it, it will generate the array P(I) and list the first 20 items, the integers from 1 to 20, on the screen. Press the keys as described in the preceding list and notice how you can scroll back and forth through the list as many times as you wish. Press R when you are done and the program will stop.

To adapt this to your own program, make sure that the dimension in line 1060 is at least as big as your output file. Then set MX in line 5030 to the exact length of your output file. The array that you want to print out goes in line 5070.

This routine should make it easier for you to examine long output listings when you don't have a printer to which to dump them. □

Alfred J. Bruey, 201 S. Grinnell St., Jackson, MI 49203.

Listing 1.

```
100 REM **********************
110 REM * PSEUDO-SCROLLING EXAMPLE
120 REM * BY ALFRED J. BRUEY      *
130 REM ****************************
140 REM * SET FOR NO. LINES OUTPUT *
150 REM ****************************
160 DIM P(100)
170 REM * INITIALIZE ARRAY TO SCROLL
180 FOR I=1 TO 100
190 P(I)=I
200 NEXT I
210 REM * GO TO SCROLL ROUTINE
220 GOSUB 5000
230 PRINT" END OF PROGRAM"
240 STOP
250 END
5000 REM ******************
5010 REM PRINT SUBROUTINE *
5020 REM ******************
5030 MX=100 ' REM NO. OF LAST LINE
5040 F=1:L=20
5050 PRINT"□"
5060 FOR I=F TO L
5070 PRINT P(I)
5080 NEXT I
5090 PRINT:PRINT"□TO SCROLL PRESS U,D,/,*,F,L,R■"
5100 GET S$:IF S$="" THEN 5100
5110 IF S$="U" THEN F=F-20:L=L-20:GOTO6000
5120 IF S$="D" THEN F=F+20:L=L+20:GOTO6100
5130 IF S$="/" THEN F=F-1:L=L-1:GOTO6000
5140 IF S$="*" THEN F=F+1:L=L+1:GOTO6100
5150 IF S$="F" THEN F=1:L=20:GOTO5050
5160 IF S$="L" THEN L=MX:F=MX-19:GOTO5050
5170 IF S$="R" THEN RETURN
5180 GOTO5100
6000 IF F<=0 THEN F=1:L=20:GOTO5050
6050 GOTO 5050
6100 IF L>MX THEN L=MX:F=MX-19:GOTO5050
6150 GOTO5050
READY.
```

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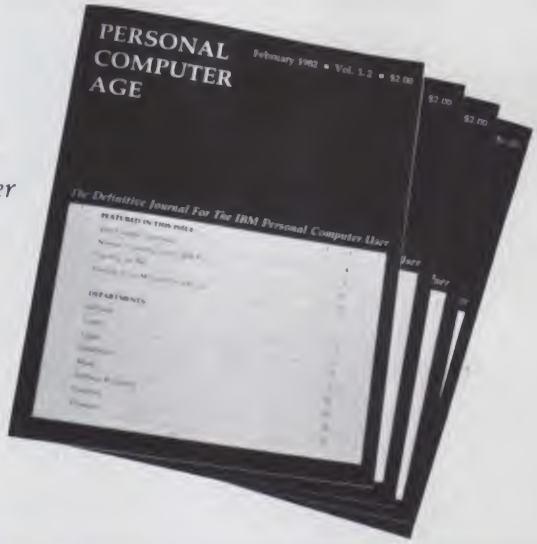

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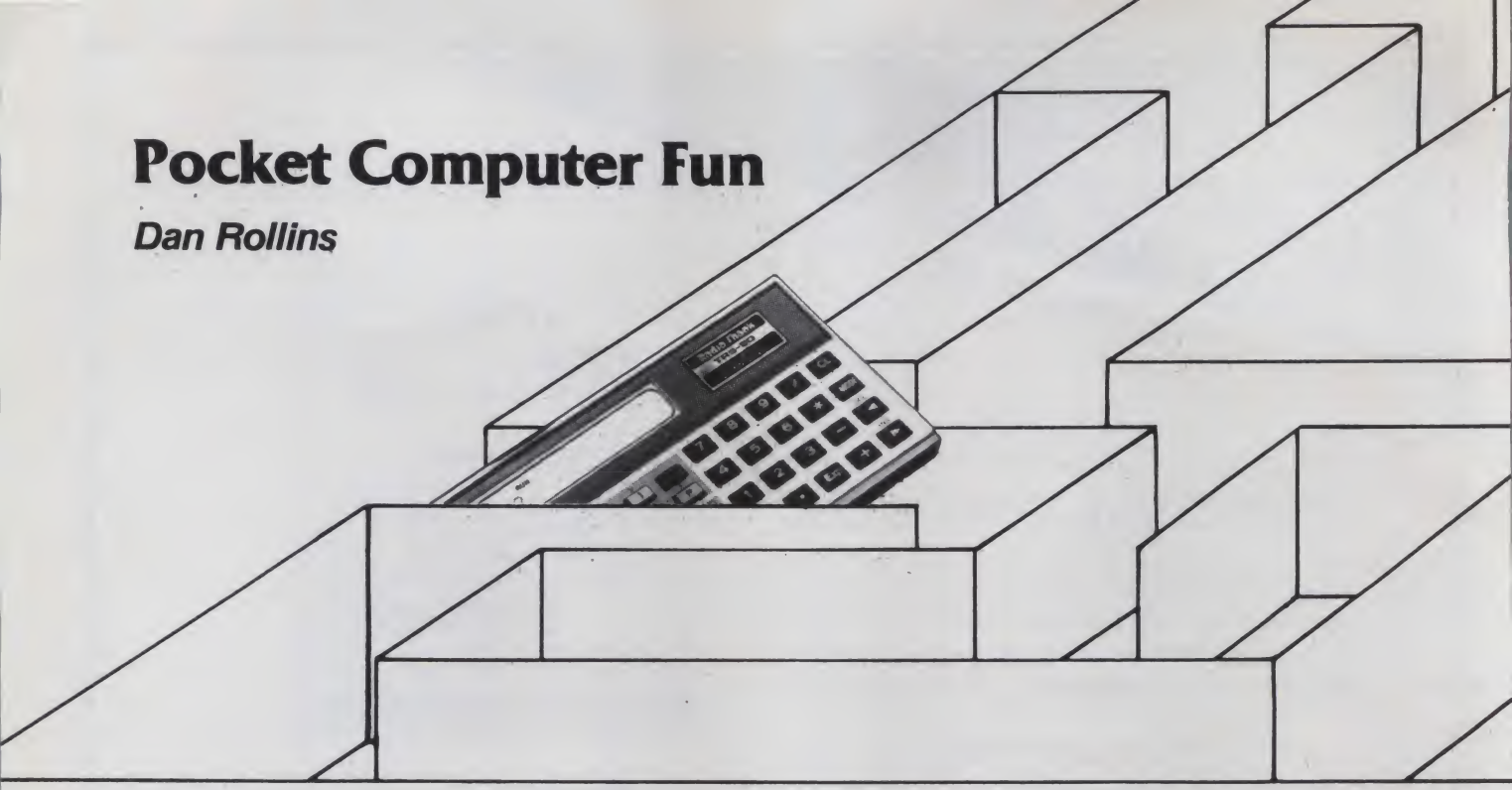

The Radio Shack Pocket Computer is not much larger than a check book, but it packs the power of a machine which, 20 years ago, would have filled a room and required scores of technicians to operate.

Though it lacks some of the qualities which I suspect will be seen in the next generation of small computers—notably tele-communications (easy hookup with a larger computer), multiple line screen, full musical capability, and such Basic commands as PEEK, POKE, USR, and INKEY$—it is, nevertheless, a good buy.

Most of the software being written for this little beauty is business related. The Radio Shack Games package is not quite what I was looking for, so I wrote the following program to give my pocket companion something to do when it is away from the office.

Pocket Maze

Pocket Maze prints a randomly created maze on your pocket computer printer. The algorithm guarantees only one direct path from entrance to exit.

The program adjusts an X,Y pointer through a two-dimensional array, adding "door" values to initially zero cells. Each configuration of doors (combination of UP, DOWN, LEFT, and RIGHT) must have a unique value for decoding in the print routine. By assigning to the various directions values which are powers of 2 as follows,

UP =1
RIGHT =2
LEFT =4
DOWN =8

any combinations will be unique and easily converted. This also means that the highest value a cell will ever attain is 15.

Since the maze can be only seven cells across (printer limitations) and memory is still "expensive" in the Pocket Computer, I decided to pack one line of cells into a single "memory." A cell on the farthest left border will give its line the value of its doors times 1.

The second column of cells is saved as DOORS * 16, the third as DOORS * 256. Thus, the value of the cell is the Xth nibble within the maze array element defined by the Yth ordinate.

The subroutine in line 3 returns the value of this nibble in the variable W. Using this routine cuts memory usage by a factor of 7, but increases program execution time.

The example maze (7 by 10) took 22 minutes to generate and print. The program flashes the number of cells left to keep you informed as to its progress. But, while scanning for a new opening after getting stuck, it will take a long time to make a move. This usually happens toward the end, so patience is a plus.

Table 1. Pocket Maze Variables Table.

A$-G$ = A$(1 to 7)	Printer output line
H-N = A(8 to 14)	Powers of 16 table (I = 16)
O	Not used (looks like 0)
P	Temp value = 31 + Y
Q	Height of maze
R	Count of unused cells
S	Count of valid directions (1 to 4)
T	Temp X for subroutine 3
U	Temp Y for subroutine 3
V	Not used
W	Return value from subroutine 3 a nibble from 0 to 15
X	Current horizontal maze ordinate
Y	Current vertical maze ordinate
Z	Random number (fraction)
A$(27 to 30)	List of valid directions
A(31 to MEM)	Maze array, each element holds values of 7 cells

Dan Rollins, 370 N. Cerritos, Apt. 15-A, Azusa, CA 91702.

Description of the Program

Line 1: Begin execution via RUN or Shift-M (DEF mode).

Line 2: Subroutine returns pseudo-random number less than 1.

Line 3: Subroutine returns a 4-bit value for a multiple of a power of 16—value of a maze cell.

Lines 4-7: Routines update cell values and X,Y pointer.

Line 10: Get a random number seed and print it. A given seed will generate the same maze for a given height.

Line 20: Get maze height and adjust for 0th array element.

Line 30: Clear maze array.

Line 40: Create look-up table for powers of 16. This avoids "accuracy errors" associated with exponentiation and increases the speed of the program.

Line 50: Give top left cell a door on top (entrance to maze), initialize X and Y to 0, determine total number of cells.

Line 60: This is the top of the MAIN loop. Decrements cell counter, flashes assurance, and checks for done.

Line 70: Initialize valid direction counter and temporary Y.

Lines 80-120: Determine valid directions, placing them in list.

Line 130: If at least 1 valid direction, choose randomly.

Line 140: —Else scan across and down.

Line 150: Check new cell. If it has a door, check to see if it adjoins a doorless cell by running through main loop (sans counter decrement).

Line 160: —Else scan further.

Line 300: DRAW maze. A maze may be redrawn with Shift-D. Send a line feed and set up loop counters.

Lines 310-320: Check for door UP and save correct value for output.

Line 320: Print top of each cell.

Lines 330-360: Determine and print side walls of each cell.

Line 380: Print bottom line. Exit may be placed anywhere.

This may seem like a large program to create a tiny maze, but a much longer maze (7 by 50 or so) is possible. But it would take a long time to produce.

Notice that the print routine builds an output line by moving string values into A$(1) to A$(7). These are later printed via PRINT A$;B$;C$;D$;E$;F$;G$. A$(1) is a redefinition of A$, as A$(2) is a redefinition of B$, etc. It is not possible to leave a trailing semicolon (;) after printing a value. So line 320 can't simply:

```
PRINT "+";
```

as in Level II Basic. It is also illegal to:

```
PRINT A$(X); A$(X+1);
A$(X+2); etc.
```

Each output string must be either a letter variable name (i.e. C$) or an array variable subscripted by an integer value such as A$(3). □

Example Maze.

```
RND SEED=98765.
HEIGHT  = 10.

+ +-+-+-+-+-+-+-+
I         I     I I
+-+-+ + + + + + +
I     I I I     I
+ + +-+ + +-+-+
I I I   I       I
+ + +-+-+-+-+ +
I I   I   I I I
+ +-+ + + + + +
I I I I I       I
+ + + + +-+ +-+
I I   I   I     I
+-+ +-+-+ +-+ +
I   I       I I I
+ +-+ +-+-+ + +
I   I I       I I
+-+ + + +-+-+ +
I I     I   I I
+ +-+-+-+ + + +
I         I     I
+-+-+-+-+-+-+ +
```

Listing 1.

```
 1:"M"GOTO 10
 2:Z=9821Z+.211
   327:Z=Z-INT
   Z:RETURN
 3:W=INT (A(31+
   U)/A(8+T)):W
   =W-INT (W/I)
   *I:RETURN
 4:"LEFT"A(P)=A
   (P)+4A(8+X):
   X=X-1:A(P)=A
   (P)+2A(8+X):
   GOTO 60
 5:"RIGHT"A(P)=
   A(P)+2A(8+X)
   :X=X+1:A(P)=
   A(P)+4A(8+X)
   :GOTO 60
 6:"UP"A(P)=A(P
   )+A(8+X):Y=Y
   -1:A(P-1)=A(
   P-1)+8A(8+X)
   :GOTO 60
 7:"DOWN"A(P)=A
   (P)+8A(8+X):
   Y=Y+1:A(P+1)
   =A(P+1)+A(8+
   X):GOTO 60
10:INPUT "RANDO
   M SEED? ";Z:
   PRINT "RND S
   EED=";Z
20:INPUT "HEIGH
   T OF MAZE? "
   ;Q:PRINT "HE
   IGHT  = ";Q:
   Q=Q-1
30:FOR X=31TO 3
   1+Q:A(X)=0:
   NEXT X
40:FOR X=0TO 6:
   A(8+X)=16^X:
   NEXT X
50:A(31)=1:X=0:
   Y=0:R=(Q+1)*
   7
60:R=R-1:PAUSE
   R;" CELLS TO
    GO":IF R=0
   GOTO 300
70:S=0:U=Y
80:IF XLET T=X-
   1:GOSUB 3:IF
   W=0LET S=1:A
   $(27)="LEFT"
90:IF X<6LET T=
   X+1:GOSUB 3:
   IF W=0LET S=
   S+1:A$(26+S)
   ="RIGHT"
100:T=X
110:IF YLET U=Y-
   1:GOSUB 3:IF
   W=0LET S=S+1
   :A$(26+S)="U
   P"
120:IF Y<0LET U=
   Y+1:GOSUB 3:
   IF W=0LET S=
   S+1:A$(26+S)
   ="DOWN"
130:IF SGOSUB 2:
   P=31+Y:GOTO
   A$(27+INT (Z
   S))
140:X=X+1:IF X>6
   LET X=0:Y=Y+
   1:IF Y>QLET
   Y=0
150:T=X:U=Y:
   GOSUB 3:IF W
   GOTO 70
160:GOTO 140
300:"D"PRINT " "
   :FOR U=0TO Q
   :FOR T=0TO 6
   :GOSUB 3
310:IF W/2=INT (
   W/2)LET A$(T
   +1)="+-":
   GOTO 330
320:A$(T+1)="+ "
330:NEXT T:PRINT
   A$;B$;C$;D$;
   E$;F$;G$;"+"
340:FOR T=0TO 6:
   GOSUB 3:IF W
   >7LET W=W-8
350:IF W<4LET A$
   (T+1)="I ":
   GOTO 370
360:A$(T+1)="  "
370:NEXT T:PRINT
   A$;B$;C$;D$;
   E$;F$;G$;"I"
380:NEXT U:PRINT
   "+-+-+-+-+-+-+
   -+ +"
```

Twonky Revisited

G. R. Hertel

My TRS-80 arrived early in 1978. Unable to wait for Level II, I had "taken the plunge" with a 16K Level I machine. I spent hours learning and experimenting with the limitations and surprising capabilities of Level I.

One of the first "real" programs I entered was a game from *Creative Computing* (May-June, 1977). The game, by Mark Capella, was called Twonky.

From the description it looked like an interesting game and the challenge of translating it into Level I Basic made it doubly appealing. Once the conversion of the two-dimensional matrix into the single available one-dimensional array was worked out, the translation went smoothly and the program worked. It proved to be an interesting game.

In case you have misplaced your May-June 1977 issue of *Creative Computing*, let me briefly explain Twonky. In the game, you are trapped in a 15 x 15 square maze which contains blocked squares, relocation squares (which randomly relocate you), an objective, a super-maze square (which starts the game over by setting up a new maze), and a Twonky.

To win you must reach the objective square before the Twonky reaches you. The Twonky chases you relentlessly, oblivious to all obstacles, and your only options are to run from him or shoot him. If hit, he is relocated randomly somewhere in the maze.

The only real problem is that you play this whole game in the dark. After every move, the computer tells you the distance between you and the objective and between you and the Twonky.

Level I proved to be a more powerful programming language than I had expected, but, when Level II chips became available, I was ready. I had my TRS-80 upgraded and took off into a multi-dimensional, multi-functional world. I eventually returned to Twonky and typed in the program essentially as it was originally written.

It was the same game, of course, except that it ran much faster. I dressed the game up with some graphics and gave the player a "malfunctioning tricorder which was activated by the relocation field." It printed the maze and flashed your position, the Twonky, and the objective for a few seconds (I always did want to see the maze) whenever you were relocated.

Twonky was eventually stored away and almost forgotten.

Recently, I was introduced to the game of Chase (I admit I haven't been keeping up on computer games) on a computer that wasn't really meant to play games. As games go, it did not impress me.

The program was rather cumbersome; movement was slow and not at all exciting. It occurred to me, however, that it would be rather easy to put TRS-80 graphics into the game and make it really interactive.

(For those readers, like me, who are not familiar with computer games, Chase plunks you down in a field containing electrified posts and surrounded by an electrified fence. There are several robots who continuously move toward you. Both you and the robots are annihilated upon hitting a post, so the object of the game is to maneuver the robots into posts as they chase you through the field.)

I wrote a version of Chase for my TRS-80 to see how fast it would run. I used the INKEY$ function and the four arrow keys to control direction and movement in real time. The game uses surprisingly little memory and is fun to play.

You are represented by a single TRS-80 graphics location (rectangle), and the electrified posts and robots are double locations or squares. The robots come at you relentlessly, trying to catch you. You destroy them by maneuvering them into one of the posts or into each other.

In my version, a robot-post encounter annihilates both. You lose if caught or if you run into a post or the border. There are three rounds of play in a game. The number of robots increases from 4 to 8 to 12 while the number of posts decreases from 80 to 60 to 40. (See Listing 1.)

While writing and playing this version

G. R. Hertel, 1500 Hibiscus Avenue, Winter Park, FL 32789.

of Chase, the similarity between robots chasing you and the Twonky chasing you occurred to me and I modified the game to conform more to the characteristics of Twonky.

In the new version, called Pursuit (Listing 2), there is one Twonky who chases you relentlessly as you try to thread your way through the maze to the flashing objective square. The Twonky homes in on you and lets nothing stand in his way.

Running into a wall either stops you cold (the blocked squares of the original game) or flips you randomly to some other spot in the maze (the relocation squares). Movement is controlled by the four arrow keys and can get frantic as the Twonky draws near or cuts off your escape route.

The darkness of the original Twonky game is gone (I always did want to see that maze) and so is the zap gun—you just don't have time to shoot in this version. It's real-time fun.

The game is set up to give you three chances, but the maze is more difficult each time. The goal (objective), Twonky, and you are identified in the game of

Program Notes for Chase

Lines 60-90 draw the border.

Lines 100-110 position posts.

Lines 120-150 select and store robot positions.

Lines 160-170 select an empty position for your starting location.

Line 180 moves you.

Lines 190-230 scan the keyboard for instruction and convert any received into horizontal or vertical instruction.

Lines 240-330 control robot movement.

The remainder of the program includes the beginning and ending routines.

Upon depressing an arrow key, you will move in that direction — one unit per move. Depressing the same key again will double your speed to two locations per move. By depressing the opposite direction key, you can slow down, stop, and reverse direction. The maximum speed is limited to two units per move.

The robots move at the constant speed of one unit per move. Thus, you can outrun the robots and even leap over posts. Diagonal movement is possible for both you and the robots.

Listing 1. Chase.

```
10 CLEAR 100
20 DEFINT A-Z
30 DIM X(30),Y(30)
40 GOSUB 390
50 W=0:R=4:ON ERROR GOTO 380
60 H=0:V=0:CLS:PRINT@1,STRING$(62,131)
70 FOR I=15360 TO 16320 STEP 64
80 POKE I,191:POKE I+63,191:NEXT
90 PRINT@961,STRING$(62,176);
100 FOR I=1 TO 80-5*R:X=RND(124)+1:Y=RND(44)+1
110 SET(X,Y):SET(X+1,Y):NEXT
120 FOR I=1 TO R
130 X(I)=RND(123)+1:Y(I)=RND(45)+1
140 IF POINT(X(I),Y(I)) OR POINT(X(I)+1,Y(I)) THEN 130
150 SET(X(I),Y(I)):SET(X(I)+1,Y(I)):NEXT
160 X=RND(124)+1:Y=RND(44)+1
170 IF POINT(X,Y)THEN 160 ELSE SET(X,Y)
180 RESET(X,Y):X=X+H:Y=Y+V:IF POINT(X,Y) THEN 340 ELSE SET(X,Y)
190 I$=INKEY$:IF I$="" THEN 240
200 IF ASC(I$)<10 THEN H=H+2*ASC(I$)-17 ELSE 220
210 IF ABS(H)>2 THEN H=SGN(H)*2:GOTO 240 ELSE 240
220 IF ASC(I$)=10 THEN V=V+1 ELSE V=V-1
230 IF ABS(V)>2 THEN V=SGN(V)*2
240 C=0:FOR I=1 TO R:IF X(I)=0 THEN 330
250 C=C+1:RESET(X(I),Y(I)):RESET(X(I)+1,Y(I))
260 X(I)=X(I)+SGN(X-X(I))
270 Y(I)=Y(I)+SGN(Y-Y(I))
280 IF (X(I)=X OR X(I)+1=X) AND Y(I)=Y THEN 370
290 IF POINT(X(I),Y(I)) OR POINT(X(I)+1,Y(I)) THEN 310
300 SET(X(I),Y(I)):SET(X(I)+1,Y(I)):GOTO 330
310 RESET(X(I),Y(I)):RESET(X(I)+1,Y(I)):RESET(X(I)-1,Y(I))
320 RESET(X(I)+2,Y(I)):X(I)=0
330 NEXT:IF C=0 THEN 350 ELSE 180
340 CLS:PRINT CHR$(23):PRINT@524,"Y O U   L O S E !":GOTO360
350 CLS:PRINTCHR$(23):PRINT@522,"Y O U   W I N ! ! !":W=W+1
360 FOR I=1 TO 1000:NEXT:R=R+4:IF R<13 THEN 60 ELSE 420
370 CLS:PRINT CHR$(23):PRINT@530,"G O T C H A ! ! !":GOTO360
380 RESUME 340
390 CLS:PRINTCHR$(23):PRINT@470,"C H A S E"
400 PRINT@800,"BY G. R. HERTEL"
410 FOR I=1 TO 1500:NEXT:RETURN
420 CLS:PRINTCHR$(23):IF W<3 THEN 450
430 PRINT@200,"Y O U   D I D   I T ! !":PRINT@454,"YOU WON ALL THREE TIMES!"
440 PRINT@704,"C O N G R A T U L A T I O N S !":GOTO 480
450 IF W=2 PRINT@396,"TWO OUT OF THREE":PRINT@592,"NOT TOO BAD!":GOTO 480
460 IF W=1 PRINT@390,"YOU WON ONCE - BIG DEAL."
470 IF W=0 PRINT@386,"HA-HA-HA -- YOU LOST THEM ALL."
480 A$=INKEY$:FOR I=1 TO 500:NEXT:PRINT@900,"CARE TO TRY AGAIN (Y/N)?";
490 A$=INKEY$:IF A$="" THEN 490
500 IF A$="Y" THEN 50
510 IF A$<>"N"THEN 480
```


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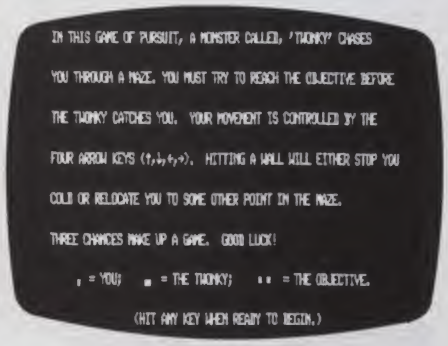
Pursuit before the maze is drawn the first time.

There are enough differences between these two games to give each its own flavor. Chase runs initially at a slower pace since movement of several robots and you must be looped through successively.

As robots are destroyed, the game speeds up until, when you and just one robot remain, you are really moving.

In Pursuit, the cycle through which the program loops moves you and the Twonky, and flashes the objective. The pace is fast and constant. In order to keep the pace fast, "relocation squares" are not specific sites. Relocation may occur (30% chance) whenever you hit a wall. Also, your destination upon relocation is not checked.



Program Notes for Pursuit

Lines 60-90 draw the border.

Lines 100-140 pick sites for you, the objective, and the Twonky; 140 checks to be sure the Twonky isn't sitting on top of you or your goal.

Lines 170-190 set up the maze.

Lines 200-220 move you, checking to see if you have hit a wall. If so, you are stopped and possibly relocated.

Lines 230-270 check for instruction from keyboard and convert it into a vertical or horizontal direction command.

Line 280 flashes the goal.

Lines 290-330 determine which way to move the Twonky.

Line 340 checks to see if you have been caught.

Line 360 checks to see if you have entered the goal.

Line 370 flashes the goal again and starts the process over.

The remainder of the program includes the beginning and ending routines.

Upon depressing an arrow, you will move in that direction until hitting a wall or depressing the opposite arrow key. Diagonal movement is possible for you, but not for the Twonky (you must have some advantage). As a result, you may find yourself inside a wall.

Don't give up, just keep trying to move out. Eventually that random number generator will come up in your favor and you will be relocated—if the Twonky doesn't get there first!

Instructions for Chase are omitted from the listing, but could be added if desired. There are brief instructions included in the Pursuit listing. Obviously, these are games designed specifically for the TRS-80. They are based upon TRS-80 graphics and functions. □

Listing 2. Pursuit.

```
10 CLEAR 100
20 DEFINT A-Z
30 GOSUB 430
40 W=0:R=0
50 RANDOM:ON ERROR GOTO 420
60 H=0:V=0:CLS:PRINT@1,STRING$(62,131)
70 FOR I=15360 TO 16320 STEP 64
80 POKE I,191:POKE I+63,191:NEXT
90 PRINT@961,STRING$(62,176);
100 X=RND(123)+1:Y=RND(41)+3:SET(X,Y)
110 GX=RND(122)+2:GY=RND(41)+3
120 SET(GX,GY):SET(GX+1,GY):SET(GX-1,GY):SET(GX+2,GY)
130 TX=RND(123)+1:TY=RND(41)+3
140 IF POINT(TX,TY) OR POINT(TX+1,TY) THEN 130
150 A$=INKEY$:RESET(GX,GY):RESET(GX+1,GY)
160 SET(TX,TY):SET(TX+1,TY):GOSUB 490
170 FOR I=1 TO 100+R*50:POKE 15360+RND(1023),191
180 A=RND(13)*64+RND(60):POKE 15424+A,140
190 POKE 15425+A,140:POKE 15426+A,140:NEXT
200 RESET(X,Y):X=X+H:Y=Y+V:IF NOT POINT(X,Y) THEN 230
210 X=X-H:Y=Y-V:H=0:V=0
220 IF RND(0)>.7 THEN X=RND(124)+1:Y=RND(45)+1
230 SET(X,Y):I$=INKEY$:IF I$="" THEN 280
240 IF ASC(I$)<10 THEN H=H+2*ASC(I$)-17 ELSE 260
250 IF ABS(H)>1 THEN H=SGN(H):GOTO 280 ELSE 280
260 IF ASC(I$)=10 THEN V=V+1 ELSE V=V-1
270 IF ABS(V)>1 THEN V=SGN(V)
280 SET(GX,GY):SET(GX+1,GY):RESET(GX-1,GY):RESET(GX+2,GY)
290 RESET(TX,TY):RESET(TX+1,TY):IF TX=X OR TX+1=X THEN 330
300 IF TY=Y THEN 320
310 ON RND(2) GOTO 320,330
320 TX=TX+SGN(X-TX):GOTO 340
330 TY=TY+SGN(Y-TY)
340 IF (TX=X OR TX+1=X) AND TY=Y THEN 410
350 SET(TX,TY):SET(TX+1,TY)
360 IF (X=GX OR X=GX+1)AND Y=GY THEN 390
370 RESET(GX,GY):RESET(GX+1,GY):SET(GX-1,GY):SET(GX+2,GY):GOTO 200
380 CLS:PRINT CHR$(23):PRINT@524,"Y O U   L O S E !":GOTO400
390 CLS:PRINTCHR$(23):PRINT@522,"Y O U   W I N ! ! !":W=W+1
400 FOR I=1 TO 1000:NEXT:R=R+1:IF R<3 THEN 50 ELSE 580
410 CLS:PRINT CHR$(23):PRINT@530,"G O T C H A ! ! !":GOTO400
420 RESUME 380
430 CLS:PRINTCHR$(23):PRINT@400,"P U R S U I T"
440 PRINT@672,"BY G. R. HERTEL"
450 PRINT@896,"DO YOU WISH INSTRUCTIONS (Y/N)?"
460 A$=INKEY$:IF A$=""THEN 460
470 IF A$="N" RETURN
480 IF A$="Y" THEN 690 ELSE 450
490 IF R>0 THEN 550
500 IF X>110 THEN P1=64*INT(Y/3)+(X-10)/2 ELSE P1=64*INT(Y/3)+(X+4)/2
510 IF GX>100 THEN PG=64*INT(GY/3)+(GX-22)/2ELSE PG=64*INT(GY/3)+(GX+6)/2
520 IF TX>100 THEN PT=64*INT(TY/3)+(TX-24)/2 ELSE PT=64*INT(TY/3)+(TX+6)/2
530 PRINT@P1,"YOU!";:PRINT@PG,"THE GOAL!";:PRINT@PT,"THE TWONKY!";
540 FOR I=1TO2500:NEXT
550 FOR I=1 TO 1500:NEXT:IF R>0 RETURN
560 PRINT@P1,"     ";:PRINT@PG,"          ";:PRINT@PT,"           ";
570 RETURN
580 CLS:PRINTCHR$(23)
590 IF W<3 THEN 620
600 PRINT@200,"Y O U   D I D   I T ! !":PRINT@454,"YOU WON ALL THREE TIMES!"
610 PRINT@704,"C O N G R A T U L A T I O N S !":GOTO 650
620 IF W=2 PRINT@396,"TWO OUT OF THREE":PRINT@592,"NOT TOO BAD!":GOTO 650
630 IF W=1 PRINT@390,"YOU WON ONCE - BIG DEAL."
640 IF W=0 PRINT@386,"HA-HA-HA -- YOU LOST THEM ALL."
650 A$=INKEY$:FOR I=1 TO 500:NEXT:PRINT@900,"CARE TO TRY AGAIN (Y/N)?";
660 A$=INKEY$:IF A$="" THEN 660
670 IF A$="Y" THEN 40
680 IF A$="N"THEN END ELSE 650
690 CLS:PRINT"IN THIS GAME OF PURSUIT, A MONSTER CALLED, 'TWONKY' CHASES":PRINT
700 PRINT"YOU THROUGH A MAZE. YOU MUST TRY TO REACH THE OBJECTIVE BEFORE":PRINT
710 PRINT"THE TWONKY CATCHES YOU.  YOUR MOVEMENT IS CONTROLLED BY THE":PRINT
720 PRINT"FOUR ARROW KEYS (^,"CHR$(92);",";CHR$(93);",";CHR$(94);").  HITTING A
WALL WILL EITHER STOP YOU":PRINT
730 PRINT"COLD OR RELOCATE YOU TO SOME OTHER POINT IN THE MAZE.":PRINT
740 PRINT"THREE CHANCES MAKE UP A GAME.  GOOD LUCK!":PRINT
750 PRINTTAB(5);CHR$(132);" = YOU;     ";CHR$(140);"  = THE TWONKY;";TAB(42);"= T
HE OBJECTIVE.":PRINT
760 PRINTTAB(15);"(HIT ANY KEY WHEN READY TO BEGIN.)"
770 PRINT@806,CHR$(132)+CHR$(136);:A$=INKEY$:FOR I=1TO50:NEXT
780 IF A$="" THEN PRINT@806,CHR$(136)+CHR$(132);:FOR I=1TO 50:NEXT:GOTO 770
790 RETURN
```

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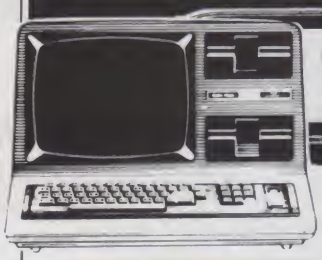

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DOS Kapital

John P. Humble

When I saw the way that my friend loaded and ran programs on his Apple computer I was a bit jealous. On my Atari I had to go through a process of making sure that I had the right disk and then making sure I didn't forget how to spell the title of the program and then typing it in.

The following is a little program that will help. I have saved this program on all my disks as MENU and now all I have to do is boot the system and type RUN D:MENU to get a list of what is in the directory of the disk. I then type the letter that is next to the name of the program that I want to run and MENU loads and runs it from the disk.

John P. Humble, 9003 W. Shorewood Dr., Apt. 703, Mercer Is., WA 98040.

```
10 GRAPHICS 0:OPEN #2,4,0,"K"
20 DIM FILENAME$(23*17),FILE$(17),F$(20)
30 OPEN #1,6,0,"D:*.*"
40 TRAP 900
45 FOR X=1 TO 64
50 INPUT #1,FILE$
55 IF FILE$(5,16)="FREE SECTORS" THEN 70
60 PRINT CHR$(64+X);"  ";FILE$:FILENAME$((X-1)*16+1,(X-1)*16+16)=FILE$
65 NEXT X
70 PRINT :PRINT "TYPE LETTER"
75 GET #2,A:A=A-64
77 FILE$=FILENAME$((A-1)*16+3,(A-1)*16+13)
80 F$="D:"
81 FOR X=1 TO 8
82 IF FILE$(X,X)=" " THEN 85
83 F$(LEN(F$)+1)=FILE$(X,X)
84 NEXT X
85 F$(LEN(F$)+1)="."
90 F$(LEN(F$)+1)=FILE$(9,11)
100 RUN F$
900 END
```

Sample output.

```
A DOS.SYS
B DUP.SYS
C MENU
D DISASSEM.BAS
E FLAG
TYPE LETTER
```

Input Without Carriage Return/Line Feed

Tom Disque

While in the process of writing a payroll and accounts receivable/payable system in TRS-80 Model I disk Basic, I encountered a perplexing problem. I wanted to display a complete record with as many as 30 fields on the screen, and to use the same section of coding as a subroutine to display the record whether adding or changing it. If the record were scrolled off the screen, one would not be able to view (and compare) all the fields of the record at one time.

When I began work on the program, I thought this would pose no problem. I had already set up the subprogram that would print out the table in Figure 1. I would simply put a semi-colon after the INPUT statement when adding a field (or PRINT when displaying fields for changes), but it didn't work.

The INPUT still prints the carriage return/line feed and wipes out the rest of the current line, as well as the next line. Then I had the idea of using the INKEY$ function, which gave birth to the program in Listing 1.

Although the subprogram is fairly simple, a couple of items should be pointed out. The check for X=8 in line 10020 is looking for a backspace. The THEN condition will take care of the variable A$, and the PRINT B$ in line 10030 will wipe out the last character on the display. The ELSE condition of line 10020 is looking for X=10 through 13, because the TRS-80 level II manual gives all four of those as the ASCII value for a carriage return.

Listing 2 gives the subprogram I used to print out the finished record. □

Tom Disque, Rt. 7, Waldrop Drive, Mayfield, KY 42066.

Figure 1.

1. EMPLOYEE NO.
2. NAME:
3. ADDRESS:
4. (address continued)
5. SOC. SEC. NO.:
6. MARITAL STATUS:
7. PAYROLL CLASS:
8. COUNTY TAX STATUS:
9. WITH INSURANCE?
10. WITH UNIFORM?
11. NO. OF EXEMPTIONS:
12. MISC. W/H:
13. AMOUNT OF :
14. GROSS PAY/HR.:
15. STARTING DATE:
16. GROSS PAY/QTR:
17. GROSS PAY/YEAR:
18. FICA/QTR:
19. FICA/YEAR:
20. FED. TAX/QTR:
21. FED. TAX/YEAR:
22. STATE TAX/QTR:
23. STATE TAX/YEAR:
24. COUNTY TAX/QTR:
25. COUNTY TAX/YEAR:
26. INSURANCE/YEAR:
27. INSURANCE/QTR:
28. UNIFORMS/QTR:
29. UNIFORMS/YEAR:

(bottom line reserved for computer query)

Listing 1.

```
10000 A$=""
10010 B$=INKEY$$:IF B$=""THEN 10010 ELSE X=ASC(B$)
10020 IF X=8 THEN A$=MID$(A$,1,LEN(A$)-1) ELSE IF X>9
      AND X<14 THEN RETURN ELSE A$=A$+B$
10030 PRINT B$;:GOTO 10010
```

Listing 2.

```
10040 FOR L=0 TO 15: FOR K=0 TO 63: LPRINT
CHR$(PEEK(15360+L*64+K));: NEXT: LPRINT: NEXT: RETURN
```

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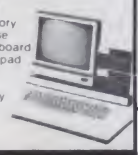

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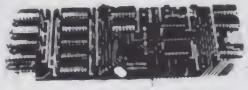

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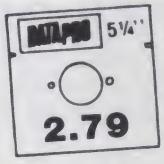

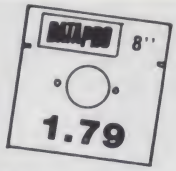

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C·H·E·C·K·E·R·S

John F. White

Many commercial programs for games of strategy are now available for microcomputers. J-Checkers has been written in Basic to illustrate some of the concepts and principles underlying these programs.

The Interpreted Basic found on virtually all microcomputers runs very slowly owing to the time required to interpret each statement. It is therefore very unusual to find a game of strategy written in this language.

Compiled languages (including the rare Compiled Basic), run about 100 times faster, while machine language is faster still. This is, therefore, the language of choice for commercial game programs. However, this leaves the rest of us unable to understand the program even when we read it.

It is customary for most programs to estimate the value of moving a piece by assessing the position which arises as a result of the move. For checkers, this would mean an assessment of each possible move of all 64 squares of the board by two FOR...NEXT loops. This is prohibitively slow in Interpreted Basic.

An alternative approach is used in Checkers, a 3 1/2 K checkers program described in *Basic Computer Games* from Creative Computing. I gratefully acknowledge the permission of David Ahl to reproduce and adapt the original Checkers for *this article.*

Checkers evaluates the merit of each move, instead of the position arising after the move. The evaluation table used for this is reproduced in Table 1.

The major problem with this approach is the poor strategic vision of the program. A piece threatened with capture will not be moved unless the move itself achieves something (other than saving the piece). The evaluation function can be built to recognize such threats to a limited extent, but the best protection is a "look-ahead" which evaluates the opponent's moves. Then the program can see that a capture by the opponent can only be averted by moving the threatened piece.

I do not have the space to consider the theoretical background behind "look-ahead." The interested reader is referred to David Levy's *Chess and Computers* (Batsford Publishers). However, it is not easy to implement recursive programming (a subroutine calling itself) in Basic and this leads to an unavoidable amount of duplication of program statements at each level of search in J-Checkers.

J-Checkers was written for a Sharp MZ-80K computer. I have used standard Microsoft Basic, but could not resist using the programmable music generator to give an audible prompt (these are the lines or subroutines with TEMP and MUSIC statements), and the use of a real-time clock is essential for the feature called Iterative Deepening (subroutine TIMER). Sharp owners will require a Tool-Kit or Expanded Basic for the string inequalities (A$<> "Y") in some lines, and for the logical operators AND and OR. I used Newbear's "Basic Extensions." PRINT"C" is a clear-screen command.

J-Checkers occupies 9K as written, or 8.3K without the instructions. Removal of all program spaces and REM statements should reduce memory requirements to less than 8K. You will be invited to select a method search from simple one-move look-ahead (one-ply), iterative deepening from one-ply or, at two-ply search, between pruned search, minimax or alpha-beta search.

Features of computerized games of strategy simulated in J-Checkers are listed below:

Evaluation Function

The evaluation function for J-Checkers is held in its own subroutine, and is summarized in Table 2 (compare with Table 1). A score is assigned to each projected move; by convention, a positive score is taken as good for the program and a negative score as bad.

I make no claim to be a good checkers player. Table 2 represents my idea of how to play, and many readers will undoubtedly wish to change the values.

Evaluation of Captures

Most programs evaluate captures until no more can be made. J-Checkers evaluates all captures to a depth of three-ply only. (This is included solely for illustration, and is frankly a waste of time for J-Checkers.) Note that double jumps are only seen by the program as a particularly favorable single jump, and it may assume

John F. White, 22, Starling Close, Woosehill, Wokingham, Berks RG11 2YY, England.

that the opponent's best reply is to use the second (captured) piece to retake the machine's piece. It would take a great deal of extra programming to avoid this.

Mini-Max Search

It is obvious that the moves made by the program can be influenced by the opponent's reply. J-Checkers contains two levels of calculation (two-ply: machine move/man move) with a third level for evaluation of captures only. At the second level, all of the opponent's replies are evaluated for each of the machine's moves. This is a slow business. The best opponent move is deducted from the machine's move to give the "backed-up" score for that move; obviously, the lower the opponent's score, the better for the program.

The moves made by the program can be influenced by the opponent's reply.

The best backed-up score is stored in location R(0), together with the moves which led to it. This avoids the necessity of storing all the moves. Finally, when all moves have been considered, the best move is displayed together with the best response which it considers that you have at your disposal.

This method of minimizing the best opponent's move so as to maximize the program's score is the famous Mini-Max search.

Alpha-Beta Search

It is not necessary to search all of the opponent's replies to see if a machine move is viable. If *any* opponent move makes the machine move worse than the one already stored as "best," then the machine need not consider any further opponent moves in response to that one machine move. This is the principle underlying the modern Alpha-Beta search, which gives identical results to Mini-Max search but in a shorter time since fewer moves are considered. (If you want to check this, be sure to remove the randomizing lines 730 and 1760 first.) Similar considerations would apply at higher levels, with the machine not needing to consider any further responses to opponent moves after finding one which is worse for the opponent.

To be really fast, the first moves generated would normally be sorted into order before applying the Alpha-Beta search, but this takes so much time in Basic as to be counter-productive for J-Checkers.

Table 1. Evaluation Function Used by Original Checkers

Projected Move	Score
Capture of opponent	+ 5
Advance of man to 8th rank (promotion to king)	+ 2
Move to side of board	+ 1
Back-up own piece from behind	+ 1
Do not approach enemy piece	- 2
Do not move off 1st rank	- 2

Table 2. Evaluation Function Used by J-Checkers

Projected Move	Score
Capture of opponent	+ 10 or + 30
Ability to make a 2nd capture after 1st	+ 9, + 10 or + 11
Advance man to 8th rank (promotion to king)	+ 2
Advance man to 7th rank	+ .3
Advance man to 6th rank	+ .2
Move man to side of board	+ 1
Move king to side of board or 1st or 8th rank	- .5
Do not move man to edge of board if it is moving to 8th rank	- 1.2
Do not approach enemy piece from front	- 3
Do not approach enemy king from rear	- 3
Back-up own piece from behind	+ 1
Do not move man off 1st rank	- 2.2
Attack enemy men from rear with king	+ 1
Move piece attacked from rear by enemy king	+ 2
Move king rather than man	+ .2
Occupy centre squares with king	+ .25
Bridge two enemy pieces with king	+ 3
Whether to exchange pieces (see text)	+ P3
Maintain opposition	+ .5
Do not move from square 3,5 (if enemy move) or from 6,4 (if program move)	- .2
END GAME: Additional functions called in the end game.	
Advance man with unopposed path to 8th rank	+ 1
If program is winning: attack enemy pieces on side or edge of board with king	+ 2
If program is losing:	
Keep king in double corner	+ 1.5
Move king towards double corner	+ .3
Keep king off side or edge of board	- .35

The opponent's best response is not printed, unlike MiniMax search, since only a good response has been found, not the best.

Interative Deepening

A very modern way of assessing moves is that of Iterative Deepening. A time is preset (for J-Checkers, use 20-150 seconds) and the machine evaluates its best move at the first level (one-ply). These moves are sorted, and subjected to Alpha-Beta search until the time runs out, at which time the best move so far discovered is displayed. Move-sorting wastes too much time for J-Checkers, but the best move at level 1 is examined first at level 2 if Iterative Deepening has been selected.

As is customary with this type of search, the move being considered by the machine is constantly displayed.

Iterative Deepening is only available for microcomputers with real-time clocks. Otherwise, this function will operate as a slightly slow Alpha-Beta two-ply search.

Pruned Search

Another popular way of searching moves in depth without spending too much time is by pruning out all moves which fail to meet a pre-determined criterion. J-Checkers can be selected to prune out all first

```
Facsimile of Screen
 Detail in Mid-game

 FROM 6, 6 TO 7, 5

   1 2 3 4 5 6 7 8
8 . X . O . X . . 8
7 O . . . . . . . 7
6 . . . O . . . O 6
5 . . . . . . X . 5
4 . . . . . . . X 4
3 . . X . . . . . 3
2 . . . . . O . . 2
1 . . O . O . O . 1
   1 2 3 4 5 6 7 8

      MOVE NO. 19

    MY TIME = 4.06

  YOUR TIME = 8.14

  END GAME

  FROM ?
```

level moves which don't achieve a positive score. This speeds up execution tremendously (see Table 3) and can give results similar to those derived by other means of searching, provided that the evaluation function is a good one. The great playing strength of the older Chess Challenger models, which used pruning, provides an excellent example.

Material Evaluation

The screen display of J-Checkers provides the opportunity to count the number of pieces on each side (one for a man, three for a king). This serves to tell whether one side has won (piece count is zero for opponent), and can also be used as in lines 1100 and 1110 to measure which side is ahead and to provide a parameter P3 which encourages exchanges of material if the program is ahead, and discourages exchanges if the program is losing. The use of P3 can be found in the third search level in line 1970. This is a commonly used algorithm found in many game programs.

End Game

For a variety of reasons, the end-game play of most computer programs (especially chess) is weaker than the mid-game. The best chess programs use extra evaluation functions when a predetermined level has been reached. Using the material evaluation outlined above, this feature has been mimicked in J-Checkers with an end-game subroutine (the program announces that it has entered its end-game).

Book Openings

Book openings can be essential if the program is to avoid opening traps. J-Checkers includes just one (line 480) to prevent the disastrous opening line: 2,6-1,5;3,3-4,4;1,7-2,6;4,6-5,5; 4,6x6,4; 7,3 x 5,5; 6,6 x 4,4; 5,3 x 3,5 x 1,7 when white is a piece up.

Random Moves

To prevent the machine always playing the same responses to its opponent, J-Checkers includes two randomizing lines (lines 730 and 1760) which randomly select between moves of equal merit.

J-Checkers can be selected to prune out all first level moves which don't achieve a positive score.

Screen Display

Far too many commercial programs provide beautiful and incomprehensible graphics for their games of strategy. J-Checkers uses the barest possible display to save memory. The number of moves is displayed as are the times elapsed for each player (the times are given in minutes and hundredths of a minute, not seconds).

Input of Moves

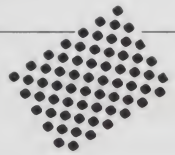
Several error-trapping routines have been written for J-Checkers, but the computer will not force you to make a capture (although it is required to do so).

In summary, J-Checkers, which uses a superior evaluation function and move searching, plays a much stronger game than the original Checkers, at the cost of two and a half times the memory requirement and between two and 22 times the original response period.

For the reasons given at the beginning of this article, it is unlikely to play as well as a machine-code program. □

Table 3. Average Time Spent on a Move.

Level	Search	Time (minutes)	% of maximum time
2	Minimax	2.24	100
2	Alpha-Beta	1.35	60
2	Pruned	0.45	20
1-2	Iterative Deepening (set to 45 seconds)	0.71	30
1	Level 1	0.21	10
1	Original "Checkers"	0.10	5



```
100 PRINT"@"
110 PRINTTAB(16);"J-CHECKERS"
120 PRINTTAB(5);" by Creative Computing\ J.F.White"
130 DIM R(4),T(4),S(8,8)
140 FORX=1TO8:FORY=1TO8:READJ:IFJ=15 THEN 160
150 S(X,Y)= J:GOTO170
160 RESTORE: READS(X,Y)
170 NEXT Y: NEXT X
180 DATA 1,0,1,0,0,0,-1,0,0,1,0,0,0,-1,0,-1,15
190 FORZ=1TO2000:NEXT:PRINT:PRINT:PRINT
200 PRINT"THIS IS THE GAME OF CHECKERS. BLACK IS 'X' AND WHITE IS 'O'"
210 PRINT"SQUARES ARE REFERRED TO BY A COORDINATE SYSTEM"
220 PRINT"(1,1) IS THE LOWER LEFT CORNER"
230 PRINT"(1,8) IS THE UPPER LEFT CORNER"
240 PRINT"(8,1) IS THE LOWER RIGHT CORNER"
250 PRINT"(8,8) IS THE UPPER RIGHT CORNER"
260 PRINT:PRINT"THE COMPUTER WILL TYPE '+ TO'
    WHEN YOU  HAVE ANOTHER JUMP"
270 PRINT:   PRINT    "TYPE '0,0' IF YOU CANNOT JUMP."
280 PRINT:PRINT"YOU WILL BE ASKED WHICH TYPE OF COMPUTER
    SEARCH YOU WANT"
290 PRINT"PRUNED SEARCH IS FASTER"
300 PRINT:PRINT:INPUT"SEARCH LEVEL(1-2)?";L
310 IFL=1 THEN 330
320 GOTO 360
330 INPUT"DO YOU WANT ITERATIVE DEEPENING(Y\N)?";ID$
340 IFID$="Y"THEN INPUT"SET TIME FOR SEARCH (SECS)";
    ST:AB$="Y":GOTO410
350 GOTO 410
360 INPUT"DO YOU WANT PRUNED SEARCH(Y\N)?";FA$
370 IF FA$="Y"THEN 410
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380 INPUT"DO YOU WANT ALPHA-BETA SEARCH (Y\N)?";AB$
390 IF AB$="Y"THEN 410
400 PRINT"DEFAULT TO MINIMAX SEARCH"
410 INPUT"DO YOU WANT TO GO FIRST(Y\N)?";C$
420 GOSUB2000:TB=TA
430 R(0)= - 99: G= -1:P1= 12:P2=12
440 IF C$="Y" THEN C1$="X":C2$="O":C3$="O*":C4$="X*":M=M+1:GOTO 910
450 C1$="O":C2$= "X": C3$ = "X*": C4$="O*"
460 M=M+1
470 IFID$="Y"ANDL=2THENX=R(1):Y=R(2):B=G:FORA=-1TO1STEP2:GOSUB570:NEXT
480 IFM=2 ANDS(2,6)=0THENR(1)=3:R(2)=7:R(3)=2:R(4)=6:GOTO790
490 FOR X = 1TO 8:FOR Y = 1 TO 8:IF S(X,Y)>-1 THEN520
500 IFS(X,Y)=-1 THEN B=G:FORA=-1 TO 1 STEP2:GOSUB570:NEXT
510 IFS(X,Y)=-2 THEN FORB=-1TO1 STEP2:FORA=-1 TO 1 STEP2:
    GOSUB570:NEXT:NEXT
520 NEXT Y : NEXTX
530 IFID$="Y" AND ID=0 AND L<2 THEN L=L+1:GOTO 470
540 ID = 0:IF ID$="Y" THEN L=1
550 GOTO 780
560 REM FIRST MOVE GENERATOR
570 IF ID=1 THEN RETURN
580 U=X+A:V=Y+B:IFU<1 OR U>8 ORV<1 OR V>8 THEN RETURN
590 IFS(U,V)=0 THEN GOSUB640:RETURN
600 IFS(U,V)<0 THEN RETURN
610 U=U+A: V=V+B: IFU<1 ORU>8 ORV<1 OR V>8 THEN RETURN
620 IFS(U,V) = 0 THEN GOSUB640
630 RETURN
640 UA=U:VA=V:XA=X:YA=Y:ED=1:GA=G
650 GOSUB 2040:Q0=Q
660 IF ID$="Y"THEN 700
670 IFQ0>8 THEN GOSUB 1480:GOTO720
680 IF FA$="Y" AND Q0   >0THEN GOSUB 1480:GOTO 720
690 IF FA$="Y" THEN 720
700 IF AB$="Y" AND L=2 THEN GOSUB 1480:GOTO720
710 IFL=2THEN GOSUB 1480:GOTO720
720 IFQ0 >R(0) THENR(0)=Q0:R(1)=X:R(2)=Y:R(3)=U:R(4)=V:GOTO 750
730 IFQ0=R(0)AND RND(1)>.5 THEN R(0)=Q0:
    R(1)=X:R(2)=Y:R(3)=U:R(4)=V:GOTO750
740 GOTO770
750 IFID$="Y"THENPRINT"I AM CONSIDERING ";R(1);",";R(2);" TO ";
    R(3);",";R(4)
760 T1=T(1):T2=T(2):T3=T(3):T4=T(4)
770 Q0=0:RETURN
780 IFR(0)=-99 THEN 1420
790 PRINT"■■■FROM ";R(1);",";R(2);" TO ";R(3);",";R(4):R(0)=-99
800 IFR(4)=1THENS(R(3),R(4))=-2 :GOTO820
810 S(R(3),R(4))=S(R(1),R(2))
820 S(R(1),R(2))=0:IFABS(R(1)-R(3))<>2THEN910
830 S((R(1)+R(3))/2,(R(2)+R(4))/2)=0
840 X=R(3):Y=R(4):IFS(X,Y)=-1THENB=-2:FORA=-2TO2STEP4:GOSUB880
850 IFS(X,Y)=-2THENFORA=-2TO2STEP4:FORB=-2TO2STEP4:GOSUB880:NEXT B
860 NEXTA:IFR(0)<>-99THENPRINT" TO ";R(3);",";R(4):R(0)=-99:GOTO800
870 GOTO910
880 U=X+A:V=Y+B:IFU<1 OR U>8 OR V<1 OR V>8 THEN RETURN
890 IFS(U,V)=0 AND S(X+A/2,Y+B/2)>0THEN ID=0: GOSUB 640
900 RETURN
910 PRINT:GOSUB2000:TD=TA:TF=TF+INT((TD-TB)/60*100+.00001)/100
920 P1=0:P2=0
930 FOR Y = 9 TO 0STEP-1:FORX=0TO 9
940 IFY=9AND(X=0 OR X=9)THEN 1030
950 IFY=0 AND (X=0 OR X=9)THEN 1030
960 IFY=0 OR Y=9THEN PRINTTAB(2*X-1);X;:GOTO1030
970 IF X = 0 OR X=9 THENPRINTY;:GOTO1030
980 IFS(X,Y)=0THENPRINTTAB(2*X);".";:GOTO1030
990 IFS(X,Y)= 1THEN PRINTTAB(2*X);C1$;:P1=P1+1:GOTO1030
1000 IFS(X,Y)=-1THENPRINTTAB(2*X);C2$;:P2=P2+1:GOTO1030
1010 IFS(X,Y)=-2THENPRINTTAB(2*X);C3$;:P2=P2+3:GOTO1030
1020 IFS(X,Y)=2THENPRINTTAB(2*X);C4$;:P1=P1+3
1030 NEXTX
1040 IFY=6 THENPRINTTAB(25);"MOVE NO. ";M;
1050 IFY=4 THENPRINTTAB(23);"MY TIME= ";TF;
1060 IFY=2 THEN PRINTTAB(21);"YOUR TIME= ";TG;
1070 PRINT:NEXT Y:PRINT
1080 IF P1=0 THEN 1410
1090 IFP2=0THEN1420
1100 IFP1>P2THENP3=(P1-P2)*P1/P2
1110 IFP2>P1 THEN P3=(P1-P2)*P2/P1
1120 IF P1<7 OR P2<7 THEN PRINT"END GAME "
1130 IFL=2 AND AB$<>"Y" AND FA$<> "Y" THEN 1150
1140 GOTO 1170
1150 PRINT"I have evaluated your best move as: ";
1160 PRINTT1  ;",";T2  ;" TO ";T3  ;",";T4
1170 GOSUB 1390
1180 GOSUB 2000:TE=TA
1190 PRINT:INPUT" FROM ";E,H:E=INT(E):H=INT(H)
1200 GOSUB 1390
1210 IFE<10RE>8 ORH<10RH>8THENGOSUB1440:GOTO1190
1220 IFS(E,H)<=0THENGOSUB 1440: GOTO1190
```

```
1230 INPUT" TO ";A,B:A=INT(A):B=INT(B)
1240 GOSUB 1390
1250 IFA<00RA>8 ORB<00RB>8THEN GOSUB1440:GOTO1230
1260 IFS(A,B)=0 AND ABS(A-E)<=2 AND ABS(A-E)=ABS(B-H) THEN1280
1270 GOSUB 1440: GOTO1190
1280 IFABS(A-E)=2 AND S((A+E)/2,(B+H)/2)>-1THENGOSUB1440:GOTO1190
1290 S(A,B)=S(E,H): S(E,H)=0: IF ABS(E-A)<>2 THEN 1350
1300 S((E+A)/2,(H+B)/2)=0
1310 INPUT" + TO ";A1,B1:GOSUB1390: IF A1<1 THEN 1350
1320 IFS(A1,B1)<>0 OR ABS(A1-A)<>2 OR ABS(B1-B)<>2
     THENGOSUB1440:GOTO1310
1330 E=A:H=B:A=A1:B=B1:IF B= 8 THEN S(A,B)=2
1340 GOTO1290
1350 IFB=8 THEN S(A,B)=2
1360 GOSUB2000:TB=TA:TG=TG+INT((TB-TE)/60*100+.0001)/100
1370 ID=0: GOTO 460
1380 REM BEEP-BEEP
1390 TEMPO3: MUSIC"-C0","-C0"
1400 RETURN
1410 PRINT:PRINT:PRINT"    I WIN !":PRINT:PRINT:END
1420 PRINT:PRINT:PRINT"  YOU WIN !":PRINT:PRINT:END
1430 REM REJECT MOVE
1440 TEMPO6:MUSIC"_C5"
1450 PRINT"ILLEGAL MOVE - TRY AGAIN"
1460 RETURN
1470 REM SECOND LEVEL
1480 IFID$="Y" THEN GOSUB 2000:IF TA-TB > ST-5 THENID=1: RETURN
1490 T(0)=-98:G1=1
1500 A7=S(X,Y):A8=S(U,V):S(U,V)=S(X,Y):S(X,Y)=0
1510 IF ABS(X-U)=2 THENA3=S((X+U)/2,(Y+V)/2):S((X+U)/2,(Y+V)/2)=0
1520 FOR X1=1TO8: FOR Y1=1TO8:IFS(X1,Y1)<1 THEN 1550
1530 IFS(X1,Y1)=1 THEN B1=G1:FORA1=-1TO1STEP2:GOSUB1620:NEXT
1540 IFS(X1,Y1)=2THENFORB1=-1TO1 STEP2:FORA1=-1TO1STEP2:GOSUB1620:
     NEXT:NEXT
1550 NEXTY1:NEXTX1
1560 S(X,Y)=A7: S(U,V)=A8
1570 IFABS(X-U)=2 THEN S((X+U)/2,(Y+V)/2)=A3
1580 Q0= Q0-T(0):IF FA$="Y"THEN Q0=Q0+3
1590 IFID$="Y"THEN Q0=Q0+ 3
1600 AB=0
1610 RETURN
1620 IF ID=1 OR AB=1 THEN RETURN
1630 U1=X1+A1: V1=Y1+B1:IFU1<1 ORU1>8 ORV1<1 OR V1>8 THEN RETURN
1640 IF S(U1,V1)=0 THEN GOSUB 1700:RETURN
1650 IF S(U1,V1)>0 THEN RETURN
1660 U1=U1+A1: V1=V1+B1:IF U1<1 OR U1>8 OR V1<1 OR V1>8 THEN RETURN
1670 IF S(U1,V1)=0 THEN GOSUB 1700
1680 RETURN
1690 REM SECOND MOVE GENERATOR
1700 UA=U1:VA=V1:XA=X1:YA=Y1:ED=8:GA=G1
1710 GOSUB 2040
1720 Q1=0
1730 IF ID$<>"Y" AND Q1>8 THEN GOSUB 1800
1740 IFAB$="Y"AND Q0-Q1 < R(0) THEN AB=1
1750 IFQ1>T(0) THEN T(0)=Q1:T(1)=X1  :T(2)=Y1:T(3)=U1  :T(4)=V1
1760 IFQ1=T(0) AND RND(1)>.5 THEN T(0)=Q1:T(1)=X1:T(2)=Y1:T(3)=U1:
     T(4)=V1
1770 Q1=0
1780 RETURN
1790 REM THIRD LEVEL
1800 IFID$="Y"THEN GOSUB2000:IFTA-TB>ST-5THEN ID=1:RETURN
1810 A4=S(X1,Y1):A5=S(U1,V1):S(U1,V1)=S(X1,Y1):S(X1,Y1)=0
1820 IFABS(X1-U1)=2 THEN A6=S((X1+U1)/2,(Y1+V1)/2):
     S((X1+U1)/2,(Y1+V1)/2)=0
1830 FOR X2=1TO8: FOR Y2=1TO8
1840 IFS(X2,Y2)>-1 THEN 1870
1850 IFS(X2,Y2) = -1 THEN B2=G:FORA2=-1TO1 STEP2:GOSUB 1920:NEXT
1860 IFS(X2,Y2)=-2THEN FORB2=-1TO1STEP2:FORA2=-1TO1STEP2:GOSUB1920:
     NEXT:NEXT
1870 NEXTY2: NEXTX2
1880 S(X1,Y1)=A4:S(U1,V1)=A5
1890 IFABS(X1-U1)=2 THEN S((X1+U1)/2,(Y1+V1)/2)=A6
1900 RETURN
1910 REM THIRD MOVE GENERATOR
1920 U2=X2+A2:V2=Y2+B2:IF U2<1 OR U2>8 OR V2<1 OR V2>8 THEN RETURN
1930 IF S(U2,V2)<=0THENRETURN
1940 U2=U2+A2:V2=V2+B2:IF U2<1 OR U2>8 OR V2<1 OR V2>8 THEN RETURN
1950 IF S(U2,V2)=0 THEN GOSUB 1970
1960 RETURN
1970 Q1 = Q1 + P3 -9
1980 RETURN
1990 REM TIMER
2000 T1$=TI$
2010 TA=3600*VAL(LEFT$(T1$,2))+60*VAL(MID$(T1$,3,2))
     +VAL(RIGHT$(T1$,2))
2020 RETURN
2030 REM EVALUATION
```


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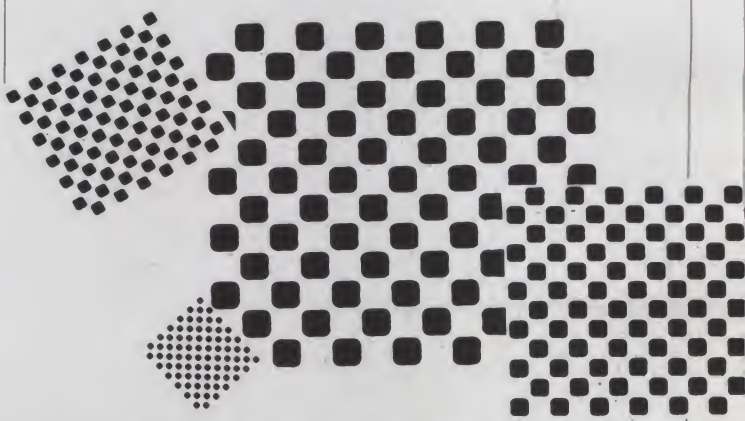
Checkers, continued...

```
2040 Q=0: IF ID$="Y"THENGOSUB2000:
     IFTA-TB>ST-5 THENID=1:RETURN
2050 IFP1<7 OR P2<7 THEN GOSUB 2530
2060 CP=0:IF ABS(VA-VA)=2 THEN Q=Q+10:CP=1:
     IF GA=-1 THENQ=Q+20
2070 IF GA=-1 AND XA=3 AND YA=5 THEN Q=Q-.2
2080 IF GA =1 AND XA=6 AND YA=4 THEN Q=Q-.2
2090 FOR C =-1 TO 1 STEP2:IFUA+C<10RUA+C>8 OR
     VA+GA<10RVA+GA>8THEN2250
2100 IFS(UA+C,VA+GA)=GA OR S(UA+C,VA+GA)=2*GA
     THENQ=Q+1
2110 IFUA-C<10RUA-C>8ORVA-GA<10RVA-GA>8THEN 2250
2120 IFS(XA,YA)=2*GA THEN 2140
2130 GOTO2170
2140 IFS(UA+C,VA-C)=0ANDS(UA-C,VA+C)=
     0ANDS(UA-1,VA+C)=-2*GA THEN 2160
2150 GOTO2170
2160 IFS(UA+1,VA-C)=-2*GA THEN Q=Q+3
2170 IF(S(UA+C,VA+GA)=-GA OR S(UA+C,VA+GA)=-2*GA)
     THEN 2190
2180 GOTO 2200
2190 IF S(UA-C,VA-GA)=0 OR (UA-C=XA AND VA-GA=YA)THEN
     Q=Q-3
2200 IF S(UA+C,VA-GA)=-2+GAAND(S(UA-C,VA+GA)
     =0OR(UA-C=XANDVA+GA=YA))THENQ=Q-3
2210 IF S(UA+C,VA+GA)=-2*GA AND (UA-C=XA AND VA-GA=YA)
     THENQ=Q-3
2220 IFUA+2*C<10RUA+2*C>8 OR VA+2*GA<10R
     VA+2*GA)>8THEN 2250
2230 IFS(UA+C,VA+GA)=0AND S(UA+2*C,VA+2*GA)=0 AND
     S(UA,VA+2*GA)=-GATHENQ=Q+.5
2240 IFS(UA+C,VA+GA)=0ANDS(UA+2*C,VA+2*GA)=0AND
     S(UA,VA+2*GA)=-2*GATHENQ=Q+.5
2250 NEXT C
2260 IF S(XA,YA)=2*GA THENQ=Q+.2:GOTO 2380
2270 REM MAN ONLY
2280 IFVA=ED THENQ=Q+2
2290 IFCP=1THEN FC=-2:FORFC=-2TO2STEP4:GOSUB2470:NEXT
2300 IFVA=ED - GA*2 THEN Q=Q+.2
2310 IFVA=ED - GA THEN Q=Q+.3
2320 IF VA=ED - 7*GA THENQ=Q-2.2
2330 IFXA=1OR XA=8THEN2360
2340 IF XA+1>8OR XA-1<1 OR VA-GA<1 OR VA-GA>8
     THEN 2360
2350 IFS(XA+1,VA-GA)=2*GA OR S (XA-1,VA-GA)=-2*GA
     THENQ=Q+2
2360 IF UA=1 OR UA= 8 THENQ=Q+1:IFVA=ED THENQ=Q-1.2
2370 RETURN
2380 REM KING ONLY
2390 IF CP=1 THEN FORFB=-2TO2STEP4:
     FOR FC=-2TO2STEP4:GOSUB2470:NEXT:NEXT
2400 IFVA=5 AND(UA=3ORUA=4ORUA=5)THENQ=Q+.25
2410 IFVA=4 AND (UA=3ORUA=4ORUA=5)THENQ=Q+.25
2420 IFUA-1<1 OR UA+1>8 OR VA-GA<1OR VA-GA>8
     THEN 2440
2430 IFS(UA-1,VA-GA)=-GA AND S(UA+1,VA-GA)
     =-GA THENQ=Q+1
2440 IFUA=1 OR UA=8 THENQ=Q-.5
2450 IF VA=1 OR VA=8 THEN Q=Q-.5
2460 RETURN
2470 UC=UA+FB:VC=VA+FC
2480 IFUC<1ORUC>8 OR VC<1ORVC>8THEN RETURN
2490 IFS(UC,VC)=0AND S((UC+UA)/2,(VC+VA)/2)=-GA
     THEN Q=Q+10
2500 IF S(UC,VC)=0 AND S((UC+UA)/2,(VC+VA)/2)
     =-2*GA THEN Q=Q+11
2510 RETURN
2520 REM ENDINGS
2530 IF GA = 1 THEN RETURN
2540 IF P2<6 AND P1>P2 THEN 2610
2550 IFU=3 AND S(U,1)>0 THEN Q=Q+2
2560 IFS(X,Y)<>-2 THEN 2650
2570 IFU=3 AND S(1,U)>0 THENQ=Q+2
2580 IFU=6 AND S(8,U)>0 THEN Q=Q+2
2590 IFU=6 AND S(U,8)>0 THEN Q=Q+2
2600 GOTO 2650
2610 IF(U=7AND V=1)OR(U=8ANDV=2)OR(U=1ANDV=7)
     OR(U=2ANDV=8)THENQ=Q+1.5
2620 IF8-U>U-1 AND U-1<X-1 AND 8-V<8-Y
     THENQ=Q+.3:GOTO2650
2630 IF 8-U<X-1 AND V-1<Y-1 THENQ=Q+.3
2640 IFU=1 OR U=8 OR V=1 OR V=8 THEN Q=Q-.35
2650 IFS(X,Y) <> -1 THEN 2740
2660 FOR I= V TO 1 STEP -1
2670 IF S(U,I)>0 THEN 2740
2680 IF U=8 AND S(U-1,I)>0THEN 2740
2690 IF U+1 >8 THEN 2740
2700 IF U=1 AND S(U+1,I)>0 THEN 2740
2710 IF S(U-1,I)>0 OR S(U+1,I)>0 THEN 2740
2720 NEXT I
2730 Q = Q + 1
2740 RETURN
```



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Standard Keyboard For The Atari 400

Robert Noskowicz

While shopping for a home computer, I did quite a bit of research, eventually narrowing my decision to a choice between the Atari 400 and 800. With a little more investigation I found that the only differences between the two are the three most obvious: 1) easy access to additional memory, 2) the two ROM slots and 3) the keyboard. The processors—operating systems and ROM—are exactly alike. Since Atari still has not used the second ROM slot, and the 400 can be fairly easily upgraded to 48K, the only appreciable difference is the keyboard. The 400 has a flat membrane keyboard compared to the standard typewriter keyboard on the 800. I didn't feel at that point that the differences warranted the approximate $400 additional cost for the 800, so I purchased the 400.

Robert Noskowicz, 44 York St., Old Bridge, NJ 08857.

After 6 months of use, I was extremely happy with my computer except for the keyboard. I found that the flat keyboard impairs the ability to enter data quickly as well as causing discomfort when entering a substantial amount of information into the system. I went from "I'll get used to it" to "It's not all that bad" to total exasperation.

What I will explain here is what I did to cure my problem: I added a standard keyboard to my machine.

First I opened my computer to determine how the keyboard was interfaced. I had the Atari Technical User's Notes but they did not contain any schematics for the keyboard. After calling several home computer stores to see if they had any information on changing keyboards, with no luck, I called Atari's toll free number in California. If you have ever called Atari, you already know that (like most computer manufacturers) they do not like you to make changes in their hardware and provide very little technical help.

I realized that I would have to do everything myself. The one thing I did know was that the decoding of the keyboard is done in the processor. The keyboard, in the case of the Atari, is just a bunch of momentary ON switches, 61 to be exact. I sat down with my ohm meter, went from point to point, and drew the keyboard layout (Figure 1).

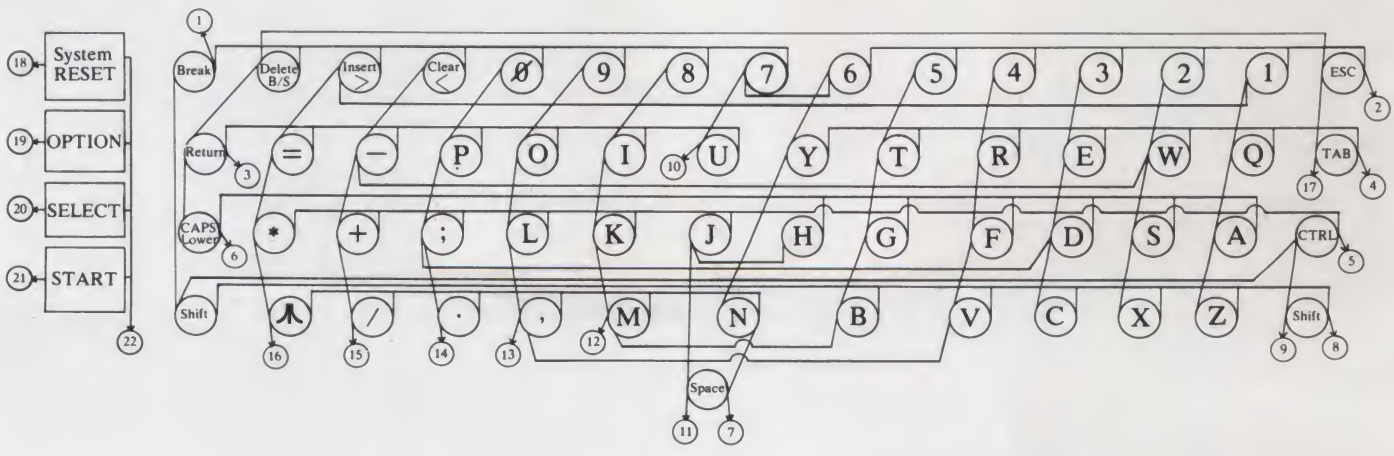

Figure 1. Ribbon cable on original keyboard is numbered 1-22. Keyboard is viewed from the back in above diagram.

Photo 1.

Photo 2.

The next step was to purchase the necessary parts. The keyboard that I bought from a firm in California has 62 keys and costs $35. It is called a bare keyboard because it is not mounted on a PC board. Initially I intended to mount the keyboard on the computer but my wife suggested that I use a cable and keep it separate.

This was an excellent idea since I keep the computer on a Parsons table in front of my TV and sitting on the couch slouching over it can be a real pain in the neck, literally. Now I can keep the keyboard on my lap which I find extremely comfortable.

If you decide to go this route, you will need about seven feet of ribbon cable which costs approximately 60 cents per foot. I used 25-conductor cable because I wanted to have a connector between the computer and the new keyboard so that I would be able to disconnect it. Otherwise it would only require 22-conductor.

The connector is a 25-pin RS-232 type made for ribbon cable. It costs about $14 per set. If you want a case for the keyboard, you can purchase one for about $56. If you are like me and wish to save some money, go to your local hardware store and buy a small Permanex tool box which costs about $6 and cut it to shape.

Some of the keys on the new keyboard are in different locations. You can leave them as is or move them about, providing you follow the wiring layout in Figure 1.

One thing I had to do on the new keyboard was to keep the Cap/Lock key from locking, since on the Atari the Cap Key does not lock.

The first step was to wire up the new keyboard (Photos 1 and 2). Since I had one extra key, I used two keys in series for system reset. This prevents me from accidentally resetting my computer.

Next I soldered the new ribbon cable to the back of the Atari keyboard where the original cable is soldered, leaving the original in place (Photo 3). You will notice that I routed the cable to one side and mounted the male connector into the side of the casing. I then assembled the computer and tested the Atari keyboard to make sure that nothing shorted. So far, everything tested OK. I then plugged my new keyboard in and tested it. It worked fine.

The keys on the new keyboard are parallel to the Atari, so either keyboard can be used. □

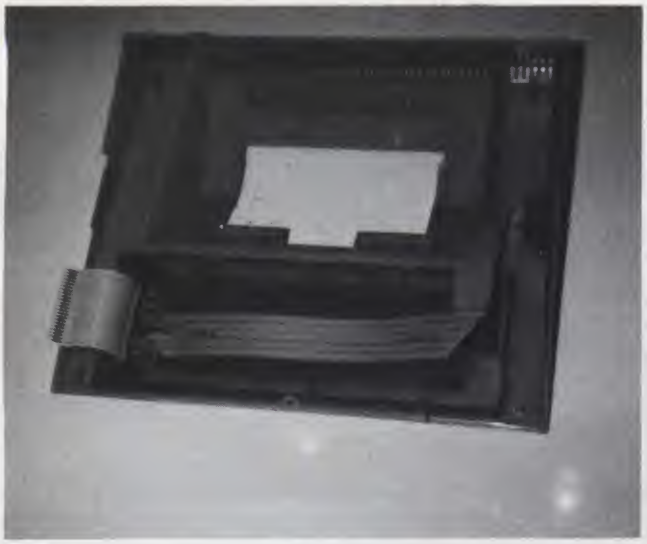

Photo 3.

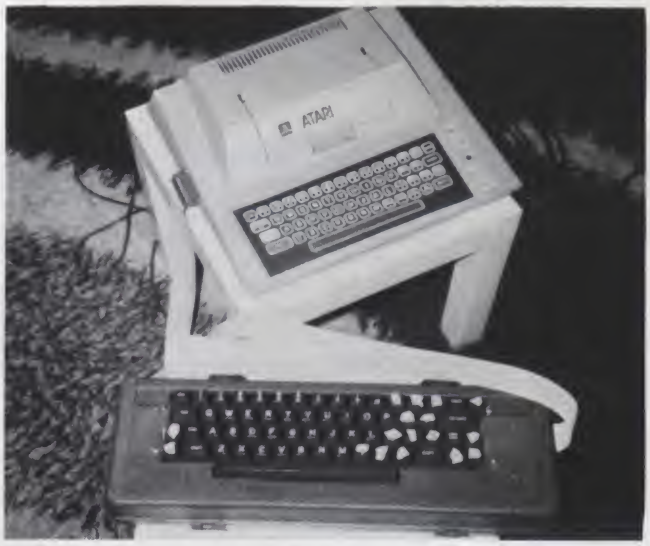

Photo 4.

How to Build an Analog to Digital Interface for Fun and Learning

Make Your Computer Into a Love Potency Meter

David H. Ahl

This simple project allows you to make your computer into a love potency meter or nervousness gauge. However, beyond the fun value, this project will show you how a digital computer can interface with an analog world.

The project makes use of the fact that the continuously variable joysticks and potentiometers (paddle controls) for many computers are either 100K or 150K ohms. Since the resistance of human skin when good contact is made is also in this range, we can substitute a human being for a potentiometer—at least as far as resistance is concerned.

The circuit is trivial. We simply put a 100K or 150K ohm resistor between the +5 volt source (at the game I/O port) and the ground so the computer has the stability of a constant load. We then let our human being grasp two connectors, one hooked to +5 volts and the other to what normally would be the center tap of the potentiometer.

Voila! The computer reads a value corresponding to the resistance of the person. We can then write a program to make the computer appear to be a love potency meter, nervousness gauge, or whatever. On a more serious note, we could also use it as a moisture gauge or, with an appropriate sensor, a light meter, density gauge, or infrared spectrometer.

TRS-80 Color Computer

For the TRS-80 Color Computer, you'll need a 5-pin, 240° D.I.N. male plug, a 100K ohm resistor, two lengths of wire (lamp cord does nicely) and two thingies that your human can grasp. I used a pair of banana plugs, but practically anything will do, including the bare wire ends. For reasons known only to Radio Shack, they don't sell the D.I.N. plug so you'll have to get it elsewhere. Be sure to get a 240° one, the more common 180° one won't fit.

Take apart the plug and solder the resistor right to the connectors. Figure 1 shows the back (or solder) side. Solder on three or four foot wires to your human connectors.

Parts for Color Computer sensor: banana plugs, disassembled D.I.N. plug, resistor.

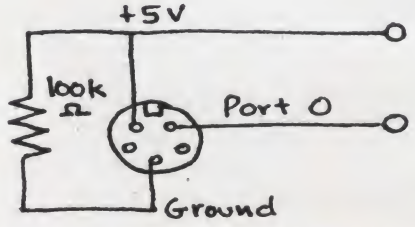

Figure 1. Circuit for TRS-80 Color Computer.

Plug the D.I.N. plug into the right joystick socket and run the following program:

```
5 CLS
10 PRINT@0 JOYSTK(0)
20 GOTO 10
```

When the connectors are apart, the screen should read 0. Touching them together should register 63. Try holding one in each hand; you should get a value between 5 and 20. Wet your fingers and hold them; now you should see 30 to 45. Hold them in a moistened palm—about 50 now. Put them both on your tongue—about 55.

Once you've got this little set up going, try the program in Listing 1. The heart of it is the two statements in lines 70 and 80 which take the resistance reading and force it into one of six outcomes.

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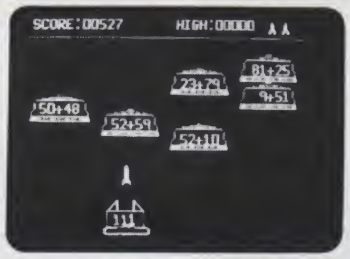

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Apple II Computer

The device for the Apple II is built exactly the same way as the one for the Color Computer except that it uses 16-pin DIP plug (or header) and a 150K ohm resistor.

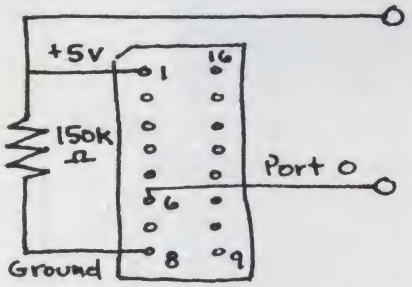


Figure 2. Circuit for Apple II.

Follow the schematic diagram in Figure 2. This shows the top (or solder) side the DIP plug. Note that the notch is by Pin 1. Be careful when soldering to the DIP plug; the plastic has a nasty habit of melting. Solder the resistor and 4-foot wires right to the plug.

Plug the finished device into the game I/O port (watch the alignment of the notch) and run the following program:

```
5  HOME
10 PRINT PDL (0)
20 FOR I = 1 TO 100: NEXT I
30 GOTO 5
```

When the connectors are apart, the screen should read 0. Putting them together should produce 255. Touching them in different ways as we suggested above should produce values in between.

Apple owners will have to make just three changes to the program in Listing 1. They are:

```
20   HOME
70   J = INT (PDL(0)/40)+1
1035 HOME
```

Atari 400 and 800

Although the Atari uses a one megohm potentiometer, no load resistor is needed at all, just two leads. The difficult thing may be finding one of those elusive DB-9 plugs of the type on the joysticks. Your best bet is an Atari VCS Service center or an old Atari joystick. You'll also need two wires and human connectors.

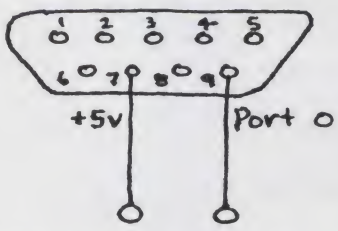


Figure 3. Circuit for Atari 400 and 800.

Solder the wires to the plug as indicated in Figure 3, plug into the left port and run the following program:

```
5  PRINT "}"
10 PRINT PADDLE (0)
20 FOR I = 1 TO 100: NEXT I
30 GOTO 5
```

Only one line in the love potency meter program need be changed:

```
70 J = 8-((PADDLE(0))/32)
```

The length of the leads and type of human connectors could necessitate adjustment of the last value (32) in Line 70.

Other Computers

The device described above may also be constructed for the IBM Personal Computer, VIC-20 and any other computer that accepts input from a continuously variable source. Simply follow the general directions above but substitute the correct input connector for your computer.

Other Control Devices

Any device which produces two or more resistance values can be "read" by the computer game port input. One with which you can have fun experimenting is an infrared photo transistor or photo resistive photo cell. Several are available for about $1.00 to $2.00. *Do not* hook up a silicon solar cell which generates a current; this can play havoc with your computer. Rather, look for a photo resistive cadmium sulfide photo cell or a resistive infrared photo transistor (a PFT-100, for example).

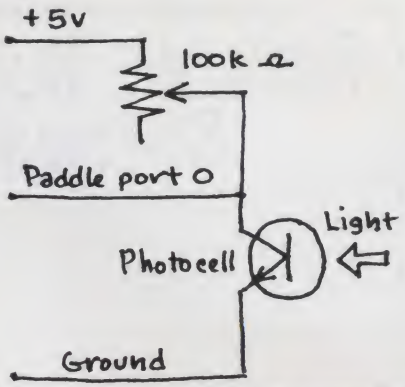


Figure 4. Control circuit to measure light intensity with a photo cell.

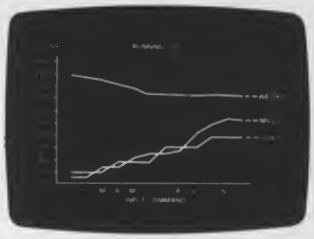
The resistance of such a device generally varies from something very low (about 250 ohms) when light is shining on it to a high resistance (12K ohms or more) when no light is present.

Use the circuit shown in Figure 4 to measure the light from the photo cell. Use a potentiometer setting to give the widest range of input values from various intensity light sources. Experiment! Have fun! □

```
10 REMARKABLE PROGRAM BY DAVID AHL
20 CLS
30 PRINT"GRAB THE TEST PROBE."
40 PRINT:PRINT"NOW SQUEEZE HARD!"
50 FOR I=1 TO 1200:NEXT I
60 PRINT:PRINT:PRINT
70 J=INT(JOYSTK(0)/10)+1
80 ON J GOTO 100,150,200,250,300,350,350
100 PRINT"MY GOSH!  YOUR HANDS ARE"
110 PRINT"LIKE A CACTUS.":GOTO 1000
150 PRINT"I'VE SHAKEN HANDS WITH A"
160 PRINT"LIMP FISH BEFORE, BUT...."
170 GOTO 1000
200 PRINT"LUKEWARM....BUT YOU'VE GOT"
210 PRINT"REAL POTENTIAL":GOTO 1000
250 PRINT"UMMMMM."
260 PRINT"NOT BAD, NOT BAD AT ALL!"
270 GOTO 1000
300 PRINT"OH MY GOODNESS!  MY CIRCUITS"
310 PRINT"ARE GOING TO OVERLOAD IN"
320 PRINT"ANOTHER NANOSECOND!!"
330 GOTO 1000
350 PRINT"I DON'T BELIEVE IT!  ARE"
360 PRINT"YOU REALLY A HUMAN?  I'VE"
370 PRINT"ONLY GOTTEN THIS KIND OF"
380 PRINT"TOUCH FROM ANOTHER COMPUTER"
390 PRINT"BEFORE.  OGLE, OGLE!"
1000 FOR I=1 TO 1500:NEXT I:PRINT:PRINT
1010 PRINT"IS THERE ANOTHER VICTIM IN"
1020 PRINT"THE HOUSE (Y OR N)";:INPUT A$
1030 IF A$="Y" THEN 20
1035 CLS
1040 PRINT"OH WELL, I GUESS NO ONE"
1050 PRINT"LOVES ME ANYMORE."
1060 PRINT:PRINT:PRINT:END
```

Listing 1.

PERSONAL FINANCE For the ATARI*800



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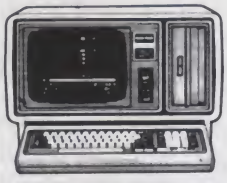

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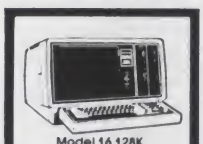

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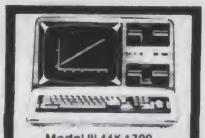

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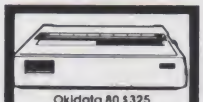

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Texas Instruments announces the System 300 Series of computers designed for small businesses. The basic model, System 340, contains the TMS99000 processor, 128K RAM, 5Mb fixed disk, and 600K of floppy disk. The top of the line System 372 includes the same processor and RAM plus a 43Mb fixed disk and a 14.5Mb tape drive. Several intermediate models are also available. On any model, RAM can be expanded to 512K. Printers and other peripherals can be added. The systems support up to three users.

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The System 1630 is a single user system with a 16 bit processor and 128K memory. It has a 5 1/4", 5Mb hard disk for files and a 630K, 8" floppy disk. Base price for

the System 1630 is $7785, plus $250 for the CP/M operating system.

The System 1650 is a multiple user, 16 bit system with 128K of memory organized on a shared logic basis. It has hard and floppy disk capabilities similar to the models 830 and 1630. The 1650, however, can support up to six workstations, each capable of accessing hard disk, floppy disk, and system printer.

Price for a basic System 1650 with two workstations is $9800, plus $650 for the MP/M-86 operating system.

Electronic Office Products, 1451 California Ave., Palo Alto, CA 94304.

CIRCLE 382 ON READER SERVICE CARD

OLYMPIA HANDHELD AND PRINTER

Olympia USA Inc. has introduced a portable computer and a new printer. The Olympia Portable Computer is based on a 6502 microprocessor, with a 65-character keyboard, a liquid crystal display panel and an internal battery pack. It weighs 21 ounces, and supports 52K bytes of RAM, plus 64K of ROM.

By using the optional acoustic modem or RS-232C interface, an Olympia Portable Computer can be connected to mainframe computers, minicomputers or other personal computers. It comes standard

with a 4K programmable memory, a 10-digit calculator, a clock/controller, and a file system.

The Olympia ESW 3000 Printer was developed for the midrange letter quality printer market, and extends Olympia's current line of lower speed printers.

The ESW 3000 incorporates an Olympia print wheel with 100 characters. Standard lettering in many typestyles, proportional spacing, four pitches, bi-directional printing and print wheel cassette insertion are also included. Print speed is 35 characters per second.

Olympia USA Inc., Box 22, Somerville, NJ 08876.

CIRCLE 383 ON READER SERVICE CARD

TERMINALS & I/O

DISK CONTROLLER CARD

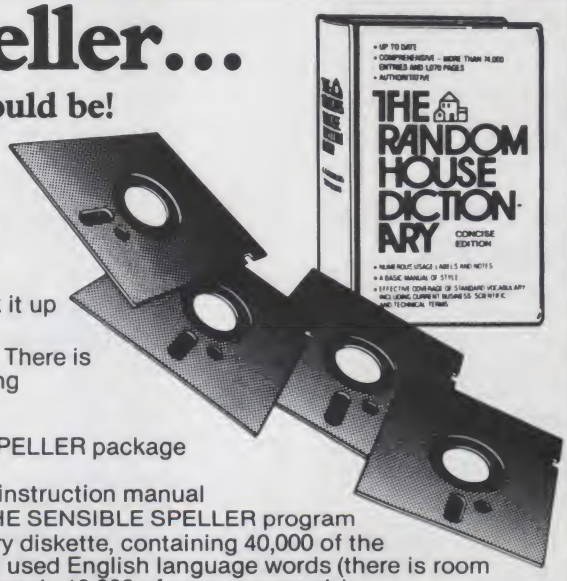
Rana Systems has announced the Elite Controller Card with four drive capability for any combination of Rana Systems Elite Minifloppy Disk Drives or Apple II disk drives. It automatically boots 13 and 16 sector diskettes, and is compatible with DOS 3.3, Pascal 1.1 and CP/M 2.20B. Other features include: improved data separation, LED indicators of operating modes and diagnostic aids, power

The Sensible Speller...

what a spelling verification program should be!

THE SENSIBLE SPELLER is the first COMPLETE spelling verification program for the Apple Computer. NO other spelling program includes as many options, or has a dictionary (on diskette) as large as ours, and includes a well known dictionary, too. THE SENSIBLE SPELLER now features the complete CONCISE EDITION of the RANDOM HOUSE® DICTIONARY. If you question the definition, pronunciation, or spelling of any word, you can simply look it up in the supplied hardcover dictionary.

Five versions of THE SENSIBLE SPELLER are available. There is no need to MUFFIN or transfer your files from one operating system to another.



Works with almost every word processor, editor, or program that generates standard DOS 3.3 TEXT or BINARY files	DOS 3.3
Works with Word Handler II	WORD HANDLER
Works with all versions of Super Text	SUPER TEXT
Works with WordStar, ED, Type Master, and any other word processor that does not compact text	CP/M
Works with the Pascal Editor and Prose.	PASCAL

THE SENSIBLE SPELLER package includes:

- an easy to read instruction manual
- two copies of THE SENSIBLE SPELLER program
- a main dictionary diskette, containing 40,000 of the most commonly used English language words (there is room to add approximately 10,000 of your own words)
- a supplementary dictionary diskette, containing the remaining 40,000 words in the RANDOM HOUSE DICTIONARY
- the hard cover RANDOM HOUSE DICTIONARY, CONCISE EDITION

THE SENSIBLE SPELLER requires an Apple II/ Apple II + equipped with 48K, DOS 3.3 and 1 or 2 disk drives. Two disk drives are required to delete or add words to the dictionary. The price is only $125.00

Sensible Software
6619 Perham Drive,
West Bloomfield, Michigan 48033
(313) 399-8877

Visa and Mastercard Welcome
Add $1.25 postage and handling per program.

APPLE is a registered trademark of APPLE Computer Company • CP/M is a registered trademark of Digital Research Corp.
SUPER TEXT is a registered trademark of Muse Software • APPLE PASCAL is a registered trademark of U.C.S.D.
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WORD HANDLER is a registered trademark of Silicon Valley Systems, Inc.

CIRCLE 308 ON READER SERVICE CARD

reduction capabilities and an improved interface buffering design.

Priced at $135., the Elite Controller Card comes with a user manual and an Elite Diskette Enhancer.

Rana Systems, 20620 South Leapwood Ave., Carson CA 90746.

CIRCLE 384 ON READER SERVICE CARD

TRS-80 PT-210 PORTABLE DATA TERMINAL

Radio Shack has introduced the TRS-80 PT-210 Portable Data Terminal. It includes a full typewriter keyboard, a thermal printer, and a 100/300 baud (Bell 103A compatible) acoustic telephone coupler. It generates 99 codes, including 67 printable characters, 32 terminal control characters, and a switch-selectable numerical keypad. $995.

An optional add-on RS232-C Interface Module featuring plug-in installation is available for $69.95.

Tandy Corporation, 180 One Tandy Center, Fort Worth, TX 76102.

PRINTACOLOR PERSONAL COLOR GRAPHICS

A color graphic ink-jet printer designed to interface with the IBM PC, Apple II, or Apple III computer has been introduced by Printacolor. The PG-1000 enables the personal computer to translate computer graphics into color hard copy. It can produce images containing over 125 shades of color, with the production time of an 8 1/2 by 11 inch image typically under two minutes.

Designed to be open-ended, the PG-100 can be upgraded through software. The ink-jet printer is packaged with an interface card, software for the IBM PC, Apple II or Apple III, 500 sheets of paper, and a disposable ink cartridge.

Printacolor Corporation, 5965 Peachtree Corners East, Norcross, GA 30071.

CIRCLE 385 ON READER SERVICE CARD

ADD-ON KEYBOARD FOR ATARI

The Sidewriter full-stroke keyboard looks and works like an Atari 800 keyboard and can be plugged into either an Atari 400 or 800.

Retail prices are $249 and $169 for installed and kit versions, respectively.

Screensonics, Inc., 14416 S. Outer 40 Rd., Chesterfield, MO 63017.

CIRCLE 386 ON READER SERVICE CARD

MICROCOMPUTER MOUSE

A high resolution digital Mouse input device from Random Access, Inc., can be used with Apple, IBM, and S-100 personal computers. The Hawley Mouse moves the cursor on a computer display screen in direct proportion to its own movement. It can be used for transferring drawings to the computer, or for cursor placement. It allows direct selection and activation of functions in menu-driven software.

The unit is composed of a decoder and a host interface card. The Mouse plugs into decoder logic housed in a small cabinet located externally to the host system.

Random Access, Inc., 246 Highland Rd., Pittsburgh, PA 15235.

CIRCLE 387 ON READER SERVICE CARD

TYPEWRITER TO PRINTER CONVERSION

Hollander Office Products has announced hardware enhancements and a price reduction to the Tyrop, an adapter designed to turn an electric typewriter into a low-cost word processing printer when interfaced with a microcomputer.

The Tyrop II has an external DIP switch to allow conversion from serial to parallel interfaces, and a new PROM that includes a backspacing key for underscoring text. The adapter is compatible with the IBM Selectric I, II, III or other equivalent electric typewriters. The printing speed for typewriters using the Tyrop II is 600 characters per minute. $695.

Hollander Office Products, 41 Duesenberg Dr., Thousand Oaks, CA 91362.

CIRCLE 388 ON READER SERVICE CARD

SMART VIDEO TERMINAL WITH AUXILARY PORT

Hazeltine Corporation announces a terminal that emulates a Televideo 950 with a green phosphor CRT. Unusual features of the device include a printer buffer, and a bidirectional auxilary RS-232 port. $895.

Hazeltine Corporation, Commack, NY 11725.

CIRCLE 389 ON READER SERVICE CARD

EXPANSION MODULES FOR ASTROCADE

Alternative Engineering offers the Viper-1 expansion kit for the Astrocade (formerly Bally) home computer.

The Viper-1 includes 16K RAM, power supply, keyboard interface, switched AC outlet, and extended Basic. Also available is the Viper system keyboard which is a 62-key full-stroke model.

Alternative Engineering Corp., P.O. Box 128, Gardiner, ME 04345.

CIRCLE 390 ON READER SERVICE CARD

GRAPHICS CARD FOR IBM PC

Frederick Electronics announces an alternative to the IBM color graphics card. The Colorplus can display four colors in the 640 x 200 pixel mode. In the 320 x 200 mode, the new board can display 16 colors. These capabilties, which correspond to the one-color and four-color modes of the standard board, also apply to 80-column and 40-column text modes.

Colorplus also contains a parallel printer port and is said to be completely compatible with existing IBM color applications. $995.

Plantronics / Frederick Electronics Corp., PC+ Products, 7630 Hayward Rd., P.O. Box 502, Frederick, MD 21701.

CIRCLE 391 ON READER SERVICE CARD

GREEN SCREEN

The BM-12EN monitor is the latest addition to the BMC line from Leading Edge Products. It is a high resolution, non-glare, green screen 12" model.

Leading Edge Products, 225 Turnpike St., Canton, MA 02021.

CIRCLE 392 ON READER SERVICE CARD

MISCELLANEOUS

PC PEDESTAL

Curtis Manufacturing Company has introduced the P.C. Pedestal for the IBM Personal Computer. Scientifically designed, the P.C. Pedestal can be tilted or swiveled in any direction for optimum viewing angle and minimum glare. Increased air circulation is provided by cooling slots styled to match the system unit. In addition, a 3' extension cable set is available to allow for extra freedom in arranging the system components.

The P.C. Pedestal is $79.95; the extension cable set is $49.95. Curtis Manufacturing, One Curtis Rd., Winchester, NH 03470.

CIRCLE 393 ON READER SERVICE CARD

DISK SYSTEMS

NEW APPLE COMPATIBLE DRIVE

The Apple-Mate 5 1/4" floppy disk drive has been introduced by Quentin Research Inc. Apple-Mate is fully transparent with DOS 3.3 and 3.2.1, as well as Pascal and CP/M in full and half track operation.

Apple-Mate also features a diskette protection system, 40 track capability, redundant write protection, and automatic power-down. $335.

Quentin Research, 19355 Business Center Dr., Northridge, CA 91324.

CIRCLE 394 ON READER SERVICE CARD

EXPANDED TRS-80 DISK STORAGE

Expanded disk drive storage for TRS-80 computers with up to four megabytes of floppy disk storage is available from Interface, Inc.

For internal storage on the Model III, there are four drives available: a single-

LET YOUR APPLE SEE THE WORLD!

The DS-65 Digisector® opens up a whole new world for your Apple II. Your computer can now be a part of the action, taking pictures to amuse your friends, watching your house while you're away, taking computer portraits . . . the applications abound! The DS-65 is a random access video digitizer. It converts a TV camera's output into digital information your computer can process. The DS-65 features:

- **High Resolution** — a 256 × 256 picture element scan
- **Precision** — 64 levels of grey scale
- **Versatility** — Accepts either NTSC or industrial video input
- **Economy** — A professional tool priced for the hobbyist

The DS-65 is an intelligent peripheral card with on-board software in 2708 EPROM. Check these software features:

- Full screen scans directly to Apple Hi-Res screen
- Easy random access digitizing by Basic programs
- Line-scan digitizing for reading charts or tracking objects
- Utility functions for clearing and copying the Hi-Res screen

HI-RES PICTURE USING THE DS-65 AND PICTURE SCANNER SOFTWARE

Use the DS-65 for precision security systems; computer portraiture; robotics; fast to slow scan conversion; moving target indicators; reading UPC codes, musical scores and paper tape and more! **GIVE YOUR APPLE THE GIFT OF SIGHT!** DS-65 Price: $349.95 / FSII Camera Price: $299.00 / Combination Price: $599.00

ADDITIONAL SOFTWARE FOR THE DS-65

—Picture Scanner: Provides a variety of different dithering algorithms for compressing the digitized image into the Hi-Res screen. Available on 13-sector disk. Price: $39.95

—Superscan: Enables you to enhance the DS-65's Hi-Res pictures with colors! Choose from 21 different colors and assign them to grey scale values, modify pictures, zoom, enhance contrast, etc. Print routines for the Anadex and Paper Tiger* are provided. Comes on a 13-sector disk. Written for The Micro Works by Magna Soft. Price: $79.95

—Portrait System Software: This program includes captions and a credit line, reverse printing for T-shirt application and the option to save portraits on disk. Specifically for use with a Malibu 165 printer. Call or write for more information.

*Paper Tiger is a trademark of Integral Data Systems, Inc.

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THE MICRO WORKS P.O. BOX 1110 DEL MAR, CA 92014 714-942-2400

CIRCLE 242 ON READER SERVICE CARD

sided drive with 40 tracks and 250K unformatted storage for $215; a single-sided drive with 80 tracks and 500K unformatted storage for $335; a double-sided drive with 40 tracks and 500K unformatted storage for $335; and a double-sided drive with 80 tracks and one Mb of unformatted storage for $435.

For external storage with the TRS-80 Models I and III, there are also four drives available; they are priced slightly higher.

Interface, Inc., 765-30 Alabama Ave., Unit 3, Canoga Park, CA 91304.

CIRCLE 395 ON READER SERVICE CARD

15Mb DISK FOR APPLE II, APPLE III, AND IBM

Davong Systems has announced a 15-megabyte version of their winchester disk drives for three different computers. At $2995, the new system sets a 5000 bytes per dollar ratio. The 15Mb drive joins a product line that also includes a 10Mb drive for $2495, and a 5Mb model for $1995.

Davong Systems, Inc., 1061 Terra Bella Ave., Mountain View, CA 94043.

CIRCLE 396 ON READER SERVICE CARD

MODEL III HARD DISK

J&M Systems Consultants have designed the JHD-III, a hard disk system for use with the TRS-80 Model III. It utilizes a 5 1/4" Winchester drive with either 5 or 10 Mb of storage. An LDOS driver is used, that allows the storage to be divided into individual logical units.

The system comes with controller, host adapter, hard disk drive, all cables, adapter software diskette, and an operator's manual. The price is $1895 for the 5 Mb system and $2095 for the 10 Mb system.

J&M Systems, Ltd., 137 Utah NE, Albuquerque, NM 87108.

CIRCLE 397 ON READER SERVICE CARD

MEMORY

64K RAM BOARD FOR ATARI

Mosaic Electronics introduces a 64K RAM board configured as 48K of fixed, contiguous RAM, and four mappable RAM banks which contain 4K each. Any one of the mappable banks can be addressed at a particular time. Since these banks do not overlap the address occupied by ROM cartridges, they are always available. $249.95.

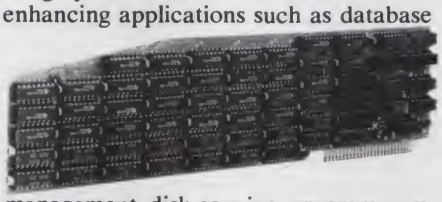
Mosaic Electronics, P.O. Box 708, Oregon City, OR 97045.

CIRCLE 398 ON READER SERVICE CARD

294K ON A CARD

Synetix Industries has announced a 294K byte memory card. The single board Solid State Disk Emulator works with the Apple II and Apple II+, and is available in 147K and 294K versions. The SSD plugs directly into any Apple I/O slot (1 through 7), and requires no external power.

The SSD is software compatible with DOS 3.3, Apple Pascal, and CP/M operating systems. Solid State Disks are for enhancing applications such as database



management, disk copying, program compiling, graphics, and other memory-intensive tasks.

Synetix Industries, 15050 N.E. 95th, Redmond, WA 98052.

CIRCLE 399 ON READER SERVICE CARD

PERIPHERALS

TELEPHONE OPERATORS FOR APPLE II

Vynet Corporation offers two different telephone operators for the Apple II. Both the V100 and V101 can answer and dial touch-tone telephones. They can also interpret digits touched by a caller during a connection. In addition, the V100 can pronounce up to 1300 words.

The speech synthesizer in the V100 can make sounds said to be indistinguishable from those coming from a tape recorder. The standard V100 has a 300-word vocabulary. A 1300 word vocabulary is also available. A demonstration of the V100 can be reached at (800) 538-7002.

Vynet Corporation, 2405 Qume Dr., San Jose, CA 95131.

CIRCLE 400 ON READER SERVICE CARD

BOOKS AND BOOKLETS

WHOLE PET CATALOG

Over 500 reviews, along with the rest of Midnite Software Gazette's first seven issues, have been expanded into a 300-page compendium called the *Whole Pet Catalog*. The volume also contains material from Jim Butterfield and other members of the Toronto Pet User Group. $10.

Midnite Software Gazette, 635 Maple, Mt. Zion, IL 62549.

NEWSLETTERS

COMMODORE NEWSLETTER

The *Strictly Commodore Newsletter* is offered for owners of the Pet, Vic-20, CBM, and Superpet computers. This monthly publication contains at least five recreational and educational programs, plus feature stories, evaluations of hardware and software, articles with programming hints and tips, and information requested by readers.

Included in each newsletter is the latest news on what's happening in the Commodore industry. Subscription rate is $18 per year; sample copy $2.

Strictly Commodore, 47 Coachwood Pl. N.W., Calgary, Alberta, Canada T3H 1E1.

APPLICATIONS SOFTWARE

EDUCATIONAL

Four software packages for young people have been announced by Spinnaker Software. **A Christmas Sampler** brings a variety of holiday classics to life on the Apple, Atari, and IBM personal computers. Animated, hi-res graphic depictions of "A Christmas Story,""The Night Before Christmas," and a selection of Christmas carols are accompanied by screen texts for say and singalongs. **Face Maker** is a software toy which presents children with an interactive experience with computers. Different faces are designed from menus of eyes, ears, hair, etc. **Story Machine** teaches young computer users how to communicate with a computer using the keyboard, while developing the ability to write sentences and paragraphs. Using a list of words, the child constructs sentences which are then animated using color and sound. **Snooper Troops** is a series of interactive mysteries. Designed for ages 10 to adult, it stimulates organized thinking and the development and testing of hypotheses. Spinnaker Software, 26 Brighton St., Belmont, MA 02178.

Card reader-based educational software programs are available. The programs include those for test scoring, grading, and record-keeping tasks, daily and term attendance accounting, and computerized achievement monitoring. These software programs are to be used on the Apple II computer. HEI, Inc., Educational Systems Department, Victoria, MN 55386. (612) 443-2500.

School Attendance System is a program that handles daily attendance accounting

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CIRCLE 235 ON READER SERVICE CARD

and reporting for up to 2600 students. It provides for eight periods per day, absences, tardiness, excuses, and early dismissals. The system for the TRS-80 Model II and Model III requires 64K of memory with two disk drives and a printer. The Model III version of the program will handle 1000 students on a 48K two disk system. Model II price is $995, and the Model III version is $650. Bertamax Inc., 101 Nickerson, Suite 202, Seattle, WA 98109. (206) 282-6249.

SofTeach is a computer-aided instruction package that helps programmers learn to use and understand UCSD Pascal. It supports application program software written in UCSD Pascal as well as Fortran-77 and Basic. The Aquizzes quiz questions the student about various aspects of the UCSD Pascal language. The Pquizzes quiz tests the student's ability to implement this knowledge by writing procedures and functions. SofTeach is $125. SofTech Microsystems, 9494 Black Mountain Rd., San Diego, CA 92126. (714) 578-6105.

Computer Assisted Instruction is available for the mentally handicapped. Colorful animated graphics programs use synthesized speech and teach basic counting and word recognition skills to those who have learning problems. This software is available for the Apple II Plus, Atari 400/800, Texas Instruments 99/4 and 99/4A, and the VIC-20 on disk and tape. $29.95. The Upper Room Computer Consultants, 907 6th Ave. East, Menomonie, WI 54751. (715) 235-5775.

The Adventures of Oswald is a combination game and story for Atari computers that incorporates voice narration, graphics, color, music, and sound effects for children between the ages of three and six. By using the joystick, a child can make Oswald walk, climb, and jump. A game, called "Oswald and the Golden Key," is also included. The cassette version, which requires 16K, retails for $16.95. The disk version, which requires 24K, retails for $23.95. Program Design, Inc., 11 Idar Ct., Greenwich, CT 06830. (203) 661-8799.

T.E.S.T. is a worksheet and test authoring program for the classroom teacher. It includes a maintenance program and a test and drill program. T.E.S.T. is available for the TRS-80 Model III. A two disk system is $24.95, and a cassette is $13.95. TYC Software, 40 Stuyvesant Manor, Genesee, NY 14454. (716) 243-3005.

RECREATIONAL

Mysterious Adventures Part 1 is an adventure in which the player has 30 puzzles to solve within a context of 60 rooms. In it the player must try to alleviate the blight and succeed where the King's Sorceror has failed. It is available on cassette or disk for the TRS-80 I/III for $19.95. Acorn Software Products, Inc., 634 North Carolina Ave. SE, Washington, D.C. 20003. (202) 544-4259.

Hayden Software branches into the realm of the arcade game with **Kamikaze**, As commander of your ship, you must ward off enemy bombs, mines, and planes. As your score increases, so does the frequency of enemy attacks. **Kamikaze** runs on the Apple II with disk, 48K, and Applesoft. It costs $34.95. Hayden Software, 600 Suffolk St., Lowell, MA 01853.

Computerware has released **Rail Runner**, a new arcade style game for the Radio Shack Color Computer and TDP System 100. The game pits the player, as railroad engineer, against the toughest train switchyard ever. **Rail Runner** is $21.95 on cassette, and $26.95 on disk. Computerware, Box 668, Encinitas, CA 92024.

STOP PLAYING GAMES

PET/CBM
APPLE
TRS-80 (Model I & III)
COLOR-80
VIC-20

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  3) Instructions on how to get the needed data from the "Daily Racing Form"
  4) Tips on using the odds generated by the program.
  5) Sample form to simplify entering data for each race.

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ISO-1

ISO-2

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CIRCLE 190 ON READER SERVICE CARD

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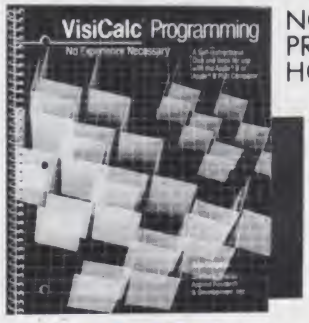

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Mystery and adventure highlight **Crypt of the Undead**, a new fantasy game for the Atari from Epyx Software. The player has twelve hours in which to set himself free from a cemetery and return to the land of the living. Should he fail, at dawn he will fall back asleep in his grave. As the player moves his joystick, the eerie contents of the graveyard unfold before his eyes in animated color graphics. **Crypt of the Undead** is available on disk for the Atari 400/800 with 32K and joystick controller. $34.95. Epyx, P.O. Box 4247, Mountain View, CA 94040.

Modec is a program which translates Morse code into characters. Written in machine language for the Apple II with DOS 3.3, Modec features a tunable audio filter that is keyboard tunable from 600 to 1500 Hz. Modec also converts Morse code to serial ASCII and sends each character to the game port. It comes on a 5 1/4" diskette and requires a patch cord for installation. $14.95. Cotec, 13462 Hammons Ave., Saratoga, CA 95070.

Snake video game requires 48K of RAM. The Snake moves about the screen, avoiding obstacles and eating food which appears at random for a short time. It is available on 5" dual format disks for Heath/Zenith computers and on 8" standard CP/M disk for systems with H19 terminals. $19.95. The Software Toolworks, 14478 Glorietta Dr., Sherman Oaks, CA 91423. (213) 986-4885.

K-Razy Kritters defies the player to save the Command Ships through ten increasingly difficult levels of play. This game is in ROM cartridge form for Atari 400 and 800 Personal Computer Systems. K-Byte, Division of Kay Enterprises Co., 1705 Austin, Troy, MI 48084. (313) 524-9878.

There are four games in the Rapidfire line: **Cytron Masters** puts the player in command of an army of cytrons who battle other cytron armies, $39.95; **Galactic Gladiators** features a collection of bizarre creatures from the Bubble galaxy, $39.95; the **Cosmic Balance** has the player assume the dual role of commander and architect of a starship fleet, $39.95; and **Shoot 'Em Up In Space** allows players to build ships from a choice of six prototypes to form squadrons and fleets, $39.95. **Guadalcanal Campaign** is a monster computer wargame that is a 40- to 80-hour-long simulation of America's most devastating conflict with Japan. $59.95. All games are designed for the 48K Apple II Plus, Apple III, or Apple II with Applesoft ROM Card. Strategic Simulations Inc., 465 Fairchild Dr., Suite 108, Mountain View, CA 94043. (415) 964-1353.

Millionaire is an educational stock market simulation game that both teaches and entertains. The game includes margin accounts, call and put options, news reports, volume indicators, and more. System requirements for Millionaire are: for the IBM PC, one disk drive, PC DOS, 64K memory, and either video board; for the Apple, one disk drive, DOS 3.3, and 48K memory; and for the TRS-80, a Model III system, one disk drive, and 48K memory. $49.95. Micro-Z Applications, 22704 Ventura Blvd., Suite #141, Woodland Hills, CA 91364. (800) 835-2246.

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m...software legal forum...s

Harold Novick

In prior "Forums," we have discussed the impact of warranties on personal computing systems. Unfortunately, one of our conclusions was that without a willing and friendly software or hardware vendor, there may be no recourse for the owner of software that does not run properly or hardware that breaks down.

In this "Forum," the problem of economically protecting the owner of an expensive system from unexpected calamities is addressed. In other words, we ask: Is there life insurance for personal computers?

In a letter to the "Forum," Stephen P. Arrants, Jr., of Oldwick, NJ, made the observation that there was a dearth of information about insurance for personal computing systems. Steve writes, "I have not seen an article—in either *Creative Computing* or any other periodical—that addresses the issue of insuring personal computer systems." Steve then suggested that this should be a topic for a future column.

While Steve may have a personal interest in this matter (he is the assistant editor of Best's Underwriting Guide, published by the A.M. Best Company, for the insurance industry), his point is well taken and I thank him for his suggestion.

If you believe legal topics are the most boring and uninteresting topics in the world, you have not been introduced to the world of insurance. A sure cure for insomnia is the reading of an insurance policy. In order not to enter into the practice of medicine, the question of insurance for personal computing systems and activities will be discussed with respect to a specific fact situation.

Assume that the insured party, whom we shall call Edward, owns a fairly sophisticated microcomputer system worth over $20,000. Such a system includes not only a respectable amount of hardware, it also includes a very respectable collection of software. This microcomputer system is used primarily for business purposes which include the management of a number of condominiums and the writing of development software under special contracts. The system is kept in a special room in Edward's home and contributes substantially to his primary source of income.

Harold Novick, Patent Attorney, Larson and Taylor, Arlington, VA 22202.

Disaster Strikes

Assume further the following: While Edward was away from home one evening, a very severe electrical storm occurred. Lightning struck the house and caused an electrical overload. This produced a voltage spike that was transmitted through the entire computer system which was on at the time.

While the house did not catch on fire, the water from the storm flooded the room in which the computer was kept. As a result of the electrical storm and the water damage, all of the hardware and peripherals were totally destroyed, and the media on which the computer programs were kept together with the supporting documentation, were ruined.

The questions then arise: What insurance should Edward have had and how fully can he be compensated?

Every insurance policy or contract has several parts. One part identifies the particular items that are insured. Another part identifies the risks that are being covered. A third part specifies the exclusions or those items and risks not covered. The remaining parts of the insurance contract specify the policy limits, the premiums, any deductibles, and a plethora of miscellaneous provisions.

So far the assumption has been made that insurance policies are available for personal computing systems. Believe it or not, that assumption is probably valid. Insurance companies with their terms and provisions are very similar to banks with their particular requirements for lending money. Thus, while the Allstate Insurance Company may not have the desired coverage for a microcomputer system, the St. Paul Fire and Marine Insurance Company might have it.

Furthermore, the terms and conditions of those companies which write such policies vary greatly, even to the extent that they may decide not to sell such a policy to certain people. In short, there are no standard criteria of insurability or of the insurance provisions that are available. Still, insurance companies are in the business to write insurance policies, and if the coverage needed is not offered, they may be convinced to provide it—even by a small businessman like Edward.

What Are The Damages

However, assume that in this hypothetical situation there was insurance for the destroyed microcomputer system. What damages were suffered in this case? First, there was the loss of the hardware system. Being a commercially replaceable system, the amount of the loss is easily ascertainable both by its initial purchase price and by its replacement cost depending upon how the insurance policy is written.

Second, the loss of the computer programs and the media on which they were stored, must be considered. In this case, the media were primarily floppy disks and magnetic tapes. Presumably, the loss of the hard disk could be included under either the hardware or the media.

For those computer programs which were purchased and used in their purchased form, the amount of the loss can be easily ascertained. On the other hand, the cost for a computer program which was either specially adapted or custom written, may be harder to ascertain. This is particularly true if the custom computer program has not been commercially sold and cannot be easily replaced. Presumably, the time and expense necessary to rewrite the software could be used as a guide as to its worth.

However, there are losses other than just the hardware and the computer programs. In this case, there was also a loss of the supporting documentation—the flowcharts, the comments to the programs, and the instructions on how to use the programs. The cost and replacement value of these documents are often not covered by commercially available insurance policies.

Another loss is called the "Extra Operating Expenses" loss. This loss is usually defined as those expenses over and above what it would normally cost Edward to conduct his computer oper-

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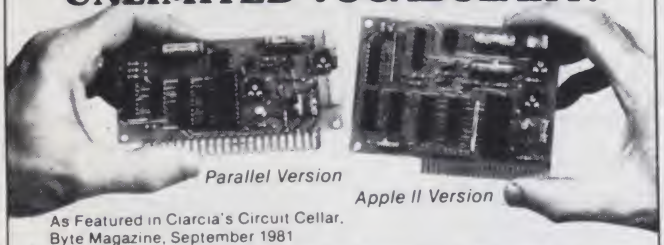

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ations had no damage occurred.

For example, in this case, it was necessary to rent an entire microcomputer system located 30 miles away to handle the condominium management task. The cost of travelling to and from the new site, the cost of any extra lodging or meals, and the rental cost above that which would normally have been paid are all included under a coverage for Extra Operating Expenses.

But that still is not everything. In this case Edward could not work full time and therefore lost part of his income as a direct result of the disaster. If Edward had "Business Interruption Insurance," then this loss would have been covered.

There is also the cost of replacing the source documentation for the condominium management business. This documentation includes the original bills and receipts from the condominium management operation and the payroll records for the employees. To cover this loss, some insurance companies offer "Valuable Papers Supplementary Coverage."

Finally, Edward may have lost some money from accounts receivable that could not be collected because of the lost records. Again, some insurance companies offer a supplementary coverage that will pay for any of these losses. Obviously, any supplementary coverage must be specifically requested, and will add to the cost of the basic policy.

Deductibles, Limits, And Exclusions

Edward was fortunate, because he had coverage for all the foregoing losses. However, that does not necessarily mean that he will be fully paid for these losses. Every insurance policy has at least two limitations to recovery, deductibles and coverage limits, and exclusions.

The deductible, simply stated, is an initial sum of money for each loss that must be borne by the insured and for which the insurance company will not pay.

Coverage limits are the maximum amount that the insurance company will have to pay for all losses due to one event. For example, in a data processing insurance policy written by the St. Paul Fire and Marine Insurance Company, the insurance company will be liable for all damages in excess of $500 but not more than $50,000 for the damage to the computer system caused by the storm.

Exclusions, on the other hand, encompass either certain risks that are not covered, (e.g., acts of war, government seizure, mechanical breakdown, programming errors, rust, and nuclear radiation) or some losses which are not covered (e.g., flowcharts and other computer program documentation).

A common exclusion which may have been applicable in Edward's case is damage caused by an electrical failure that occurs outside of the premises in which the computer system is located. For example, if the lightning had struck an electrical substation located a distance from Edward's house and either caused the damaging electrical voltage transition or resulted in the inability to operate the computer system and meet certain deadlines in preparing condominium reports, the resulting business loss would not have been covered.

In this case, the entire microcomputer system was located and operated in Edward's home and this fixed location was stated in his policy. However, if Edward had temporarily taken his microcomputer system to another location where the damage occurred, it is likely that either the damage would not be covered, or the maximum amount and type of coverage would be different.

Because of the easy transportability of microcomputer systems, this provision may be important. The possibility of damage away from the specified location also emphasizes the necessity of carefully

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reading the contract and understanding the coverage.

Other coverage not provided might include in specific cases, loss of data and media that is irreplaceable, or damage arising from a mechanical breakdown of the system which occurs independent of the perils. Thus, a mechanical breakdown from the electrical storm would be covered, but a mechanical breakdown because of a part deficiency may not be covered.

Another major part in an insurance contract is the particular limits for the policy coverage. The St. Paul policy which can be written for a microcomputer system has a $10,000 standard coverage for hardware and an automatic coverage of $7000 for the computer program and media losses. If the value of the hardware or the covered software is greater than these limits, then additional coverage must be obtained.

Other Provisions

Other provisions of the insurance contract cover miscellaneous items such as the right of the insurance company to make inspections and conduct audits, provisions for when the policy premiums must be paid and renewed, and the consequences if not done, and termination situations.

Edward's policy included an "all perils" coverage. Translated this means that the general perils of fire, flood, wind damage, water damage, and theft are covered. However, insurance companies often require installation of certain safety devices or compliance with certain safety standards before they will write the insurance. For example, Edward may have had to have installed a lightning arrestor or electrical voltage peak suppressor.

Edward already had the insurance. How did he obtain it? According to Marr T. Haack of the St. Paul Fire and Marine Company, Edward could have obtained an insurance policy for his system in two ways. If he had not used the computer system in his business, then he could have obtained a rider to his home owner's policy from his insurance agent. Such a rider, however, probably would not have included such coverages as Business Interruption and Extra Operating Expenses coverage. Of course, there is also the possibility that his insurance company does not have a rider that specifically covers computer systems. While the hardware may be covered under the general loss provisions of personal property in a home owner's policy, it is questionable whether the computer programs would be covered because they may not be classified as tangible personal property.

The other approach, and the one used by Edward to obtain insurance, is to get a standard business insurance policy that specifically covers computer systems. The insurance companies handling these policies, such as St. Paul, normally do not sell the insurance policies directly, but deal through independent insurance agents. The names of local insurance agents can be found in the Yellow Pages of the telephone directory under "Insurance" and under either the agent's name or in some cases under the name of the insurance company. In any event, using the Yellow Pages is definitely the first step in obtaining the insurance coverage. The second, more difficult step is finding someone who is familiar with computers and can write a policy.

Finally, who should obtain such a policy? The cost for the above mentioned St. Paul insurance policy might be as low as $100 a year, and should cost within the range of $100 to $250 per year, depending upon the exact nature of the coverage. At that price, anyone using a microcomputer system in his business who does not get the insurance is making a big mistake. □

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CIRCLE 168 ON READER SERVICE CARD

le cart...apple cart...apple

Chuck Carpenter

In my last column, I indicated that additional information about printing in Pascal would be included. It will be this month. Responses to the March '82 column were received from several readers. At least two were from readers who teach Pascal as a structured language. Other items to be included this month are the usual one-liners and more questions-n-answers.

Rosa Pascal Sez

Printing to physical devices in UCSD Pascal, especially the Apple version, is sometimes complicated. The first time I tried to do it was in response to a question from James Pittman. Results of the interchange were published in the March '82 column. Listings 1 and 2 were sent in response by Sharon Burrowes. Sharon (one of the teachers) felt that even further simplification and discussion were needed for the beginner. Along with the listings, she sent information from an article explaining the method. The source of the article has been lost, but the author is James Hugard. Paraphrasing the article, the rationale for this approach to printing is something like this:

- To assign a variable name to a physical device, use interactive type variables.
- Use REWRITE to assign the variable (X) to the physical device (printer) and open the file for output.
- Use the variable (X) with the command WRITELN to identify the physical device to receive the output from the REWRITE statement.

The article goes on to say that REWRITE is the key statement. It makes the physical connection between the PRINTER file, and the PRINTER: physical device.

James Hugard also recommends the book *Beginners Guide for the UCSD Pascal System*. It was written by Kenneth L. Bowles (author of UCSD Pascal) and is published by Byte/McGraw Hill. The programs and information in the book can be used with Apple Pascal. An appendix shows the specific requirements to use the text examples with the Apple.

Sharon also included information about other printing problems. For instance, it is not immediately obvious that you should use the T(ransfer) function from the F(iler) to get a listing of a program. And, if you want a compiled listing printed, you must insert (*$L PRINTER:*) in your program. Also, if you want to print a directory listing, you must specify the physical device. The method for doing this is shown on page 58 of the Operating System manual.

Other Ways Too

Another approach to the Pascal printing problem was sent by Karen L. Lopilato

Listing 1.

```
(*THIS PROGRAM SHOWS HOW TO OUTPUT TO A PRINTER IN PASCAL*)
PROGRAM PRINTOUT;

VAR X : INTERACTIVE;
   (NOTE: THIS VARIABLE WILL BE USED*)
   (*      WHEREVER PRINTER OUTPUT IS NEEDED*)

BEGIN (*PRINTOUT)
REWRITE(X, 'PRINTER:');

WRITELN(X,'THIS LINE WILL APPEAR ON THE PRINTER.');
WRITELN('THIS LINE WILL APPEAR ON THE SCREEN.');

END.  (*PRINTOUT*)
```

Listing 2.

```
(*THIS PROGRAM SHOWS ANOTHER OPTION FOR PRINTER OUTPUT IN PASCAL*)
PROGRAM PRINTOUT;

VAR X : INTERACTIVE;
   (*NOTE: THIS VARIABLE WILL BE USED*)
   (*      WHEREVER PRINTER OUTPUT IS NEEDED*)

   DEVICE : STRING[10];  (*THIS WILL BE USED TO DETERMINE *)
                         (*THE DEVICE TO BE USED FOR OUTPUT*)

BEGIN (*PRINTOUT*)
WRITELN('WHAT OUTPUT DEVICE DO YOU WISH? ');
WRITELN(' (P = PRINTER, S = SCREEN)');
READLN(DEVICE);
IF DEVICE = 'P'
   THEN DEVICE := 'PRINTER:'
   ELSE DEVICE := 'CONSOLE:';
REWRITE(X,DEVICE);

WRITELN(X,'THIS WILL APPEAR ON THE DEVICE SELECTED.');
WRITELN('THIS LINE WILL DEFAULT TO THE SCREEN.');

END.  (*PRINTOUT*)
```

Chuck Carpenter, 3714 Bishop Hill Dr., Carrollton, TX 75007.

Listing 3.

```
(*                    JAMES C. PITTMAN JR.                          *)
(*          WITH        REVISIONS -  KAREN L. LOPILATO              *)
(*            WRITE OUT A TABLE OF ASCII CHARACTERS TO A PRINTER    *)
(*    THIS IS A SAMPLE PASCAL PROGRAM TO DEMONSTRATE PRINTING INPUT AND *)
(*OUTPUT FROM WITHIN A PROGRAM. WITH CHANGE -  INITIALIZE Y TO 1 RATHER *)
(*THAN 0.  ALSO, A WRITELN(FID) HAS BEEN INCLUDED  AT END OF PROCEDURE, *)
(*DISPLAY, SO THAT LAST LINE WILL BE PRINTED WITH A "BUFFER" PRINTER.   *)
(*THIS PROGRAM DEMONSTRATES AN ESSENTIALLY DIFFERENT WAY TO OBTAIN      *)
(*OUTPUT ON THE PRINTER.  INTERACTIVE FILES ARE NOT NECESSARY; INSTEAD  *)
(*FID IS DECLARED A TEXT FILE, AND OUTPUT MAY BE TRANSFERRED TO IT WHEN *)
(*DESIRED. THIS TECHNIQUE UTILIZES STANDARD PASCAL, RATHER THAN SPECIAL *)
(*APPLE PASCAL.   APPLECART -- CREATIVE COMPUTING -- MARCH 1982         *)
PROGRAM PRINTEST(INPUT,OUTPUT);
VAR     X,Y,Z : INTEGER;
        MODE  : STRING[8];
        FID   : text;

PROCEDURE  DATA;                    (* GET "LINE WIDTH" INPUT.        *)
BEGIN
  WRITELN(FID); (* "FILEID" OR IDENTIFIER OF A PREVIOUSLY DECLARED FILE *)
  WRITELN(FID,'ENTER AN INTEGER BETWEEN 7 AND 26,');
  WRITELN (FID,'OR 0 TO STOP. ');
  READLN(Z);WRITE(FID,'  (',Z,')')
END;
PROCEDURE DISPLAY;                                  (*WRITE SOME OUTPUT *)
BEGIN
  Y := 1;                           (* INITIALIZE LINE WIDTH          *)
  WRITELN(FID);                     (* Y SET TO 1.                    *)
  FOR X := 32 TO 127 DO
    BEGIN (*FOR*)
      WRITE(FID,' ',CHR(X),' '); Y := Y+1;
      IF Y > Z THEN
        BEGIN
          Y := 1;
          WRITELN(FID)
        END; (*IF*)
    END; (*FOR*)
    WRITELN (FID)                   (*WRITELN NECESSARY HERE, OTHERWISE AN  *)
                                    (*INCOMPLETE LAST LINE WON'T BE PRINTED *)
                                    (*ON SILENTYPE PRINTER, OR ANY PRINTER  *)
                                    (*THAT PRINTS LINE BY LINE.             *)
END; (* DISPLAY *)
BEGIN (* MAIN *)
  Z := 1;
  WHILE Z <> 0 DO
  BEGIN
    WRITELN;
    WRITELN('SELECT EITHER CONSOLE: OR PRINTER:');
    READLN(MODE);
    REwrite(FID,MODE);
    DATA;
    IF Z<> 0 THEN
      DISPLAY;
    CLOSE (FID);
  END (* WHILE *)
END. (* MAIN *)
```

e.g.: Centronics 737
MX-80

Listing 4.

```
PROGRAM TYPEWRITER;
VAR  STRANG : STRING;
     P  : TEXT;

     BEGIN

REWRITE(P, 'PRINTER:XX.TEXT');
REPEAT
READLN(STRANG);
IF STRANG='*' THEN EXIT (PROGRAM);
WRITELN(P,STRANG);
UNTIL STRANG='*';
CLOSE(P);
END.
NOW IS THE TIME
FOR ALL GOOD MEN
TO COME TO THE AID
OF THEIR COUNTRY.
```

Example of program use. Each line ends with return.

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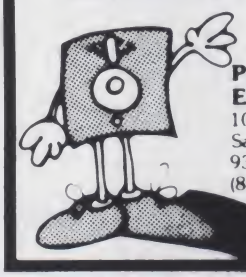

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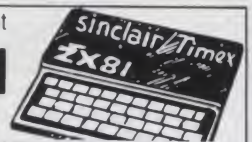

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CIRCLE 267 ON READER SERVICE CARD

Apple Cart, continued...

and is shown in Listing 3. This example, a modification of the one by James Pittman, shows how to print from a program without interactive files. Karen also demonstrated a technique for directing the output to either the console or the printer from within the program. It is a much longer program, though, and I chose to include the simpler, shorter one. The program (Listing 3) is well annotated and should be easy to understand.

John R. McClenon's contribution in Listing 4 lets you use the Apple as an uppercase typewriter. It accepts a line of text which you can correct until you press RETURN. When RETURN is pressed, the line of text is passed to the printer. With lowercase capability added you could use this as a primitive text processor. John also suggests using the Pascal text editor to create a file. Pascal 1.1 has upper and lowercase capability. Once you have created a text file, you can transfer the file to the printer using the available F(iler) commands.

Our last contribution for this session was sent by Verne Thomas. Verne was experiencing some problems with his CPS Multifunction card. He has to set the printer parameters for use with Pascal from Basic. The March '82 article stimulated his thinking, and the program in Listing 5 was the result.

With this program you can send character font and control codes to your printer. According to Verne, "it is procedure SETPRINTER that actually sets up the printer. Within is included a procedure RESTORE which insures

Listing 5.

```
PROGRAM PRINTER;
 VAR CHOICE      : CHAR;
     OUTFILE     : TEXT;
 PROCEDURE SETPRINTER;
  VAR PRINT       :INTEGER;                (*STORES PRINT STYLE CHOICE*)
      PRINTERFILE:TEXT;                    (*SENDS CHOICES TO PRINTER*)
  PROCEDURE RESTORE;                       (*SETS DEFAULT CHOICES*)
   BEGIN
     WRITE(PRINTERFILE,CHR(27),CHR(72));
     WRITE(PRINTERFILE,CHR(27),CHR(70));
     WRITE(PRINTERFILE,CHR(18));
     WRITE(PRINTERFILE,CHR(20));
   END;
  BEGIN                                    (*SETPRINT*)
    PAGE(OUTPUT);  GOTOXY(4,1);
    WRITELN('**BE SURE PRINTER IS TURNED ON**');
    GOTOXY(13,4);WRITELN('PRINTER SETUP');  GOTOXY(0,6);
    WRITELN('1. DOUBLE STRIKE PRINT.');
    WRITELN('2. EMPHASIZED PRINT.');
    WRITELN('3. COMPRESSED PRINT.');
    WRITELN('4. DOUBLE WIDTH PRINT.');
    WRITELN('5. STANDARD PRINT.');
    WRITELN('6. **EXIT**');
    WRITELN;  WRITELN('MORE THAT ONE MODE IS POSSIBLE.');
    WRITELN('ENTER CHOICES ONE AT A TIME.');
    WRITELN;  WRITELN('ENTER CHOICE: ');
    REWRITE(PRINTERFILE,'PRINTER:');  RESTORE;
    REPEAT
     (*$I-*) (*TURN OFF ERROR CHECKING TO AVOID FATAL ERROR*)
     REPEAT
      GOTOXY(14,16);  READLN(PRINT);
      (*SETS CURSOR,  READS ENTRY*)
     UNTIL (PRINT >0) AND (PRINT<7) AND (IORESULT = 0);
     (*$I+*) (*TURN ON ERROR CHECKING AFTER GOOD ENTRY*)
     CASE PRINT OF
      1:WRITE(PRINTERFILE,CHR(27),CHR(71));
      2:WRITE(PRINTERFILE,CHR(27),CHR(69));
      3:WRITE(PRINTERFILE,CHR(15));
      4:WRITE(PRINTERFILE,CHR(14));
     END;
     GOTOXY(14,16);  WRITE(' ');           (*ERASES PRIOR ENTRY*)
    UNTIL PRINT = 6;
    CLOSE (PRINTERFILE);
 END;                                      (*SETPRINTER*)
BEGIN                                      (*PRINTER*)
 REPEAT
  PAGE(OUTPUT);
  REPEAT
   GOTOXY(0,12);  WRITE('SET PRINTER TYPE STYLE?(Y/N)--> ');
   READ(CHOICE); GOTOXY(32,12); WRITE(' ');
  UNTIL (CHOICE = 'Y') OR (CHOICE= 'N');
  IF CHOICE= 'Y' THEN
    BEGIN
     SETPRINTER;
     REWRITE(OUTFILE,'PRINTER:');
     WRITELN(OUTFILE,'THIS IS THE STYLE THAT IS PRINTED.');
     WRITELN(OUTFILE);  CLOSE(OUTFILE);
    END;
 UNTIL CHOICE = 'N';
END.                                       (*PRINTER*)
```

default values each time the procedure is entered. Thus, SETPRINTER could be included as a block in any program 'as is' since it requires no external parameters. Of course, procedure RESTORE must always have the appropriate entries to maintain a default setting each time SETPRINTER is called."

The program is for the Epson MX-80 but I think you could adapt it to other printers without much trouble. Just substitute the control codes for your printer for those of the MX-80. You can add other codes and controls to the procedure as required, too. My thanks to the contributors of these Pascal routines. As I have mentioned before, my skills in Pascal are limited. Therefore, these programs are included with very little checking.

Also, the disk sent to me by Karen, and the neat single-page program from Verne were greatly appreciated. The task of preparation is greatly simplified when I don't have to type the programs sent to me for the column. Usually copies made on thermal printers don't copy well. Neither do things printed with blue ink. Blue is optically invisible unless it has some red or black in it. Note, too, that if you want things returned, a stamped and return-addressed package is required.

One Liners

Some of the single-line programs I have received recently are quite elegant. It is amazing how much program you can pack into 255 characters. Of course it takes a great deal of creativity and effort to do it, so maybe it is not so amazing after all.

Listing 6 is a screen dump routine for the MX-70 printer from Bob Barash. The sample run shows what the program can do. As Bob points out, the program is a one-liner if you type it in using the ? for PRINT and eliminating the spaces. This is fair for typing since the Basic Interpreter will list it in proper form anyway. For hi-res page 2, use 16384 instead of 8192. Bob notes that some people pay as much as $50 for programs that do this.

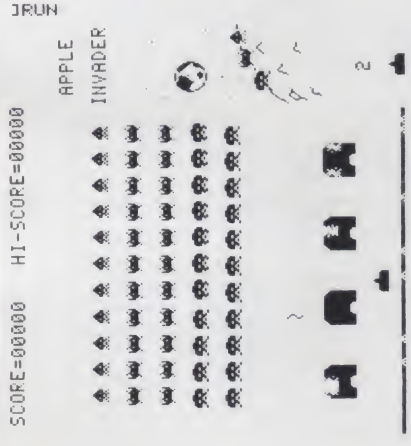
Steven Wong, a repeat contributor, sent the program in Listing 7. This program turns the Apple into a drawing pad using lo-res graphics. We haven't had too many lo-res programs, so this one is a refreshing change.

The program in Listing 8 comes from Ivan Rous. This program only works if the random numbers work together. If all the random coordinates are close to each other, then the output is a mess. If the colors are all the same or if the color is black, the program can get quite boring. The number and size of shapes are up to the user, and can be changed as desired. Perhaps someone can suggest improvements to the program.

Listing 6.

```
2  REM HIRES PAGE1 TO EPSON MX70
4  REM TYPE ? INSTEAD OF PRINT
6  REM    BY: BOB BARASH
8  REM
10 D$ =  CHR$ (4):E$ =  CHR$ (27)
     : PRINT D$"PR#1": PRINT E$"A
     " CHR$ (7):: FOR I = 39 TO 0
      STEP  - 1: FOR J = 0 TO 80 STEP
     40: PRINT E$"K@" CHR$ (0):: FOR
     K = 0 TO 896 STEP 128: FOR L
      = 0 TO 7168 STEP 1024: WAIT
     49601,128,128: POKE 49296, PEEK
     (8192 + I + J + K + L): NEXT
     : NEXT : NEXT : PRINT : NEXT
     : PRINT E$"2": PRINT D$"PR#0
     "
```

```
]RUN
```



Listing 7.

```
10  REM  LO-RES PAD
20  REM  STEVEN WONG
30  REM  BROOKLYN,  N.Y.
40  HOME : GR : FOR C = 1 TO 1E +
     9: VTAB 21: PRINT "COLOR= "D
    %" ","X= "X" ","Y= "Y" ":Z =
     PEEK ( - 16384) - 128: POKE
     - 16368,0:X = X - (Z = 74):
    X = X + (Z = 75):Y = Y + (Z =
    77):Y = Y - (Z = 73):D% =  PDL
    (0) / 255 * 15: COLOR= 15: PLOT
    X,Y: FOR P = 1 TO 99: NEXT :
     COLOR= D%: PLOT X,Y: NEXT
```

```
                    I
Draw by using the  J K keys and
                    M

change colors by rotating Paddle 0.
```

Listing 8.

```
10  REM     FLOWERBURST
20  REM     A ONE-LINER
30  REM     BY IVAN ROUS
40  REM
50  HGR2 : FOR D = 1 TO 5:X1 =  RND
     (1) * 189 + 45:Y1 =  RND (1)
     * 100 + 45:R =  RND (1) * 1
    0 + 33: HPLOT X1 + R,Y1:C =
     INT ( RND (1) * 20) + 4: HCOLOR=
    C / 4: FOR Z = 0 TO 6.28 STEP
     .0157:J =  COS (Z * C) * R:X
     =  COS (Z) * J * 1.217:Y =
     SIN (Z) * J: HPLOT  TO X1 +
    X,Y1 + Y: NEXT Z,D: GOTO 50
```

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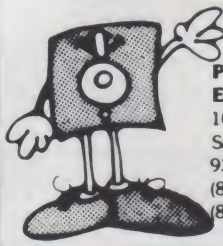

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CIRCLE 262 ON READER SERVICE CARD

One Pagers

Some of the contributions are not programs in one line, but will fit in one page on the CRT screen. Listings 9 and 10 were sent by Ron Picardi. They are the same program done in Integer Basic and Applesoft, respectively. I had to do some digging to find out what the call to -12288 did. It is a call to the lo-res graphics routine. Line 5 and the call in line 10 can be replaced with GR. These programs illustrate some of the differences needed to do the same program in either of the Apple Basic languages.

One additional graphics program is shown in Listing 11. Jim Horning sent this program which appears to have been printed on a Silentype printer. Using odd numbers for N creates a circle pattern in the center. Even numbers cross through the center.

Questions-'N-Answers

Some interesting questions have been asked recently. I would like to share my responses to some of them.

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Using a modified design of a standard Shugart Associates drive, Apple has made it possible for us to use any good-quality 5 1/4" disk. Standard drives use at least the index hole for soft-sectored systems. In hard-sectored systems, there is an index hole and as many other holes as there are sectors.

Apple uses a system of pulses to mark the beginning of a track, so the index hole is not used. In fact, the index sensor has been removed (as have the head-load solenoid and the track zero sensor). Because index and sector holes are not required in the Apple Disk II system, you can use any disk.

And a reminder too about storing programs on both sides of disks. In a single sided system the head mechanism is not designed for rerecording on both sides. A felt head-load pad is used to force the disk against the head. This head-load pad collects dirt and becomes abrasive.

Also, when you turn the disk over it must spin in the opposite direction. Any dirt collected by the liner now comes loose and passes under the head to the other side of the disk. With the abrasive head-load pad rubbing on both sides of a disk, you could be asking for trouble. The other side of single sided disks is not certified either. Modern technology is such that you will find the second side good most of the time. But, it is not guaranteed.

About Assembly Language

Most of the questions I get are about how to do specific things in assembly language. One of the recent questions asked how to generate a random number. Because Applesoft has a random number function, the code used in Applesoft can also be used for assembly language. The problem is to locate the addresses for the code in the Applesoft interpreter. But first, let me digress to provide some background information.

Assembly language as I know it requires the use of 6502 operation codes (opcodes) and related mnemonics. Mnemonics are the three letter codes assigned to each of the 55 opcodes of the 6502. See pages 118 thru 128 of the Apple II Reference Manual for a complete summary of 6502 opcodes and instructions.

The opcodes are the codes used by the 6502 internal microcode to perform various functions in machine language. Machine language is the result of assembling—at some memory location—the assembly language mnemonics (opcodes) and the operands. Operands are the addresses or data used with the opcodes to define each function to be performed.

If you examine a listing from the Apple disassembler, you can understand all these words much better. Figure 1 is an example of such a listing. A more detailed tutorial about assembly language was included in the May '80 column.

There are many good books and sources of information about 6502 assembly language. Among them are *Apple Machine Language* by Inman and Inman, *6502 Software Design* by Scanlon, and *Apple Assembly Line*. This last one is a newsletter available from S-C Software, P.O. Box 280300, Dallas, TX 75228. Subscriptions in the U.S. are $15 per year.

My favorite 6502 assembler is also available through this source. If you choose the newsletter, be sure to get all the back issues. There are many other 6502 books on the market; some are very good. Which ones you choose depends on your specific requirements. The answer to the random number question was found in the first issue of *Apple Orchard* the magazine of the International Apple Corps. (I understand that copies are still available.)

Random Numbers

Pages 12 thru 18 of the Mar/Apr 1980 IAC magazine include the Applesoft internal entry points. Since it was published, some errors have been found, but for our use there is no problem. First, look at the program in Figure 1. You will

Listing 9.

```
 1 REM  TWINKLING STARS
 5 CALL -936
10 CALL -12288: DIM N(400): FOR
   A=1 TO 400 STEP 2:N(A)= RND
   (8192)+8193:N(A+1)= RND (255
   )/64: NEXT A
20 FOR A=1 TO 400 STEP 2:B= RND
   (2): IF B=1 THEN POKE N(A),
   N(A+1): IF B=0 THEN POKE N(
   A),0: NEXT A: GOTO 20
```

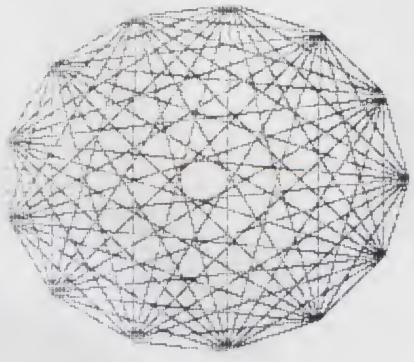
Listing 10.

```
0  REM  TWINKLING STARS
10  DIM N%(400): FOR A = 1 TO 400
     STEP 2:N%(A) =  INT ( RND (
    1 ) * 8192 + 8193):N%(A + 1 ) =
     INT ( RND (1 ) * (255 / 64))
    : NEXT : HGR
20  FOR A = 1 TO 400 STEP 2:B =  INT
    ( RND (1 ) * 2): IF B = 1 THEN
     POKE N%(A),N%(A + 1): NEXT
    : GOTO 20
30  POKE N%(A),0: NEXT : GOTO 20

]REM APPLESOFT RUNS MUCH SLOWER
```

Listing 11.

```
5  REM    ** BY JIM HORNING **
6  REM
10  HOME : DIM X(30),Y(30)
100  HGR2 : HCOLOR= 7:N =  INT ( RND
     (1) * 14 + 7):PI = 6.28318 /
     N
120  FOR I = 0 TO N - 1:Z = PI *
     I:X(I) =  COS (Z) * 107 + 14
     0:Y(I) =  SIN (Z) * 95 + 96:
      NEXT
170  FOR I = 0 TO N - 1: FOR M =
     I TO N - 1: HPLOT X(I),Y(I) TO
     X(M),Y(M): NEXT : NEXT : FOR
     T = 1 TO 1000: NEXT : GOTO 1
     00
```



Sample Run of graphics program by Jim Horning.

see the steps used to generate and display the random number. Function RND is located at address $EFAE. Remember that the $ symbol means Hex in 6502 assembly language.

In my attempts to make random numbers, I found that I could not call RND directly. The program worked for me when the RND function and the output display were called separately.

Two other routines are needed to get the random number on the screen. First you find that the output of RND is stored in memory locations called the Floating Point Accumulator (FAC). Next, you determine that you need to get FAC into a location called FBUFFER. FOUT is the routine that does this in the form of a string.

Once you have FAC in FBUFFER you can print the string on the screen using a routine called STROUT. From the program in Figure 1, you can see operands representing the addresses of these routines. Once you know where these programs are, you can examine them in detail.

For instance, if you want to use the string of numbers in FBUFFER for your own program, you can find the area of memory by reading the code for the STROUT routine. I would expect to find an indexing routine pointing to a table in memory.

New Hardware

If you want to add another drive to your system, it is easy to do with an adapter kit. Depending on what you have available, the cost of adapting varies from $60 to $320. If you have a Shugart SA 400 (or 400L) drive, the cost is lowest. A matching case is $20 more. By changing the drive select block, changing the terminator pack, adding four wires, and plugging in the adapter board, you have an Apple compatible disk drive. You can buy the drive modified or unmodified. Because of added power supply requirements, only 1 SA400 is recommended for each system. This means you can have a standard Apple and one modified unit. To connect more units, use an external power supply. The kits are available from RJ Electronics Laboratory, Box 186, Naperville, IL 60566. (312) 393-4385. □

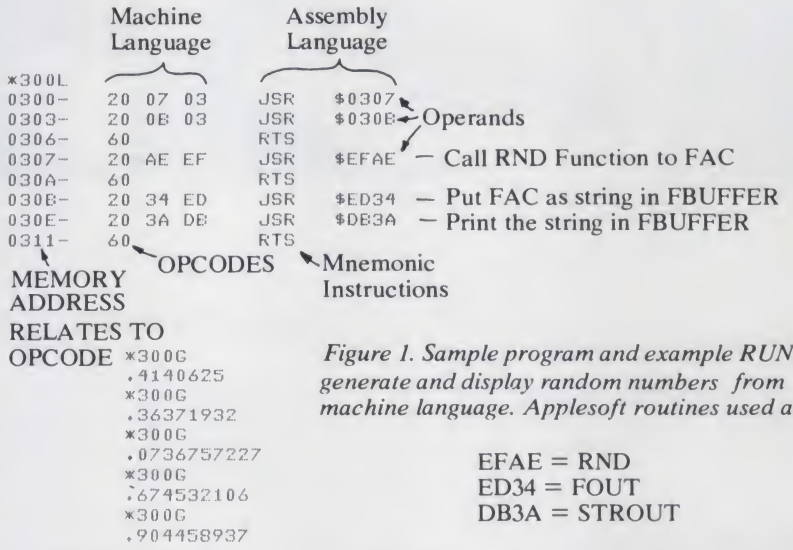


Figure 1. Sample program and example RUN to generate and display random numbers from machine language. Applesoft routines used are:

EFAE = RND
ED34 = FOUT
DB3A = STROUT

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outpost: atari

John Anderson

It's getting to be the holiday season here at the outpost, and visions of hardware, software, and peripheral *sugarplums* are surely dancing in our heads.

As a service to our readers with extremely clear specifications to Santa regarding items for placement under the tree, Figure 1 is presented. Simply fill in the blanks, and leave the magazine in an obvious spot, conspicuously open to this page. The bathroom offers an inescapable point of sale, but be creative. (Warning: those desiring software may avoid last-minute disappointment by underscoring to loved ones the fragility of diskettes. Sure, you can stuff stockings in your boots, but you won't be able to boot disks that have been stuffed in your stocking.)

Self-Modifying Programs

Original Atari Basic has its strong and weak points, as do all computer languages. Because Atari Basic is a somewhat renegade dialect, however (as opposed to the orthodoxy of Microsoft Basic), it is subject to especially intense scrutiny. Those who dislike it tend to detest it; even those who like it tend toward ambivalence. C'est la langue.

There is at least one good reason why Atari Basic is a "splinter language." It was designed in tandem with and in order to squeeze the most from the Atari operating system. And as such, it is capable of some exotic tricks—that much is undeniable.

One of these tricks is the ability to write-code that in turn rewrites itself. Imagine the possibilities.

The Atari has a very open-minded operating system. It will allow the screen editor to operate from sources other than a human at the keyboard. The editor will go so far as to accept data pushed to the screen from Atari Basic, and Atari Basic can then execute commands directly from the screen editor.

Figure 2 is a short example of how this feature can work. First we clear the screen, and position the cursor. Then we straightforwardly print code lines to the screen. These lines will act as if the Atari has automatically pushed the RETURN key over them, thus incorporating them into the program (and eliminating any previous lines with the same line numbers). Notice the inclusion of a CONTinue command. You must print this command at the bottom of any list of modifications or the program will terminate before modification takes place. The program run must actually stop, accept the new data, and start itself again.

The trickiest facet of the technique is placement of the cursor. If you position it incorrectly, you can lose modifications, or get locked into a loop. A bit of experimentation will lead to successful results.

Only now is the potential of this capability being fully explored. Two new programs from Artworx Software make use of the technique: *Drawpic* saves four color user drawings in graphics modes 3 through 7, by saving modified strings; *Player/Missile Editor* does the same for player/missile shape tables. You can get more information concerning these programs from Artworx, 150 North Main Street, Fairport, NY 14450.

A hint on how you might simply utilize the technique in your own programs is shown in Figure 3. Here the user is asked to input data, which is then incorporated into the modified program. This program can then be saved, thus saving the input information.

I've used the simplest possible approach in this example, saving up to one hundred phone numbers as REM statements. You might wish to improve radically on this approach.

Another use of the technique would be to delete lines when they are no

Figure 1.

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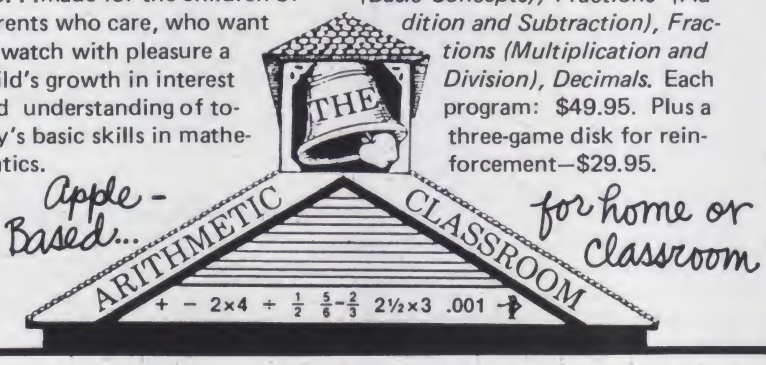

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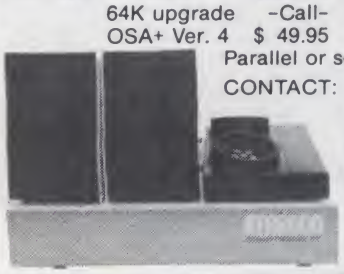

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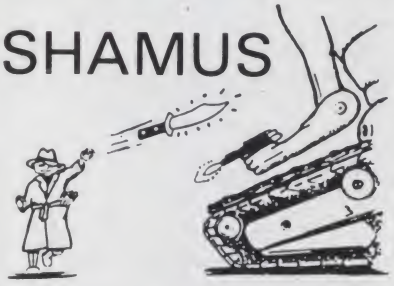

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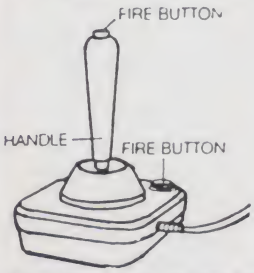

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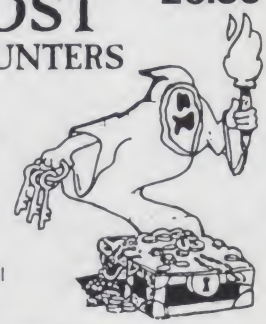

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```
10 REM SELF-MODIFYING EXAMPLE
20 GRAPHICS 0:POSITION 2,5:REM CLEAR SCREEN AND POSITION CURSOR.
   Y COORDINATE = NUMBER OF LINES TO CHANGE (5)
30 ? 110;" . THESE ARE THE LINES"
40 ? 120;" . THAT WILL REPLACE"
50 ? 130;" . THE LINES AT THE"
60 ? 140;" . END OF THE PROGRAM."
70 ? 150;" . NOTE ABBREVIATIONS REMAIN              ACCEPTABLE."
80 ? "CONT:REM THIS STATEMENT IS CRUCIAL, AND MUST NOT BE NUMBERED."
90 POSITION 2,0:REM REPOSITION CURSOR AT TOP OF SCREEN
100 POKE 842,13:STOP :REM DON'T PUT ADDITIONAL COMMANDS ON THIS LINE
105 POKE 842,12:REM POKES HALT PROGRAM, ENABLE EDITOR, ACCEPT COMMANDS,
    RETURN TO PROGRAM
110 REM WATCH THESE LINES CHANGE
120 REM TO THE LINES STIPULATED
130 REM IN LINES 30 THROUGH 70.
140 REM DON'T FORGET THE "CONT"
150 REM COMMAND AFTER LINE CHANGES!
```

Figure 2.

longer needed. Line numbers devoted to user input of variables, for example, could be deleted after the variable table has been constructed. This would help conserve memory.

Countless other applications await *your* entry into Atari behavior modification. The limits are set by your imagination only.

Souping Your Machine

Although the Atari does most things well, you can now customize it to do things better. The idea may seem to you akin to putting slicks on a BMW, but let me tell you about a few products we've tested that can make your machine faster and more versatile.

The *Fastchip,* from Newell Industries, replaces the floating point chip on the operating system board. Floating point routines, which involve mathematical operations with real numbers as well as integers, run extremely slowly on a standard Atari. Newell Industries claims that execution of these routines is boosted to three times the original rate.

I played *Hail To the Chief* twice on the same machine, once with the original chip, and once with *Fastchip.* Calculations within the program involve lengthy breaks in the action. *Fastchip* cut the waiting at least in half, from a maximum of 11 seconds to a maximum of about 5 seconds. It may not sound like much of a difference, but when you're waiting it is.

If you are into floating point routines and don't have a lot of time, *Fastchip* will help. It lists for $39.95, and installation in an Atari *800* takes less than five minutes. For more information, contact Newell Industries, 3340 Nottingham Lane, Plano, TX 75074.

You should resist with all your strength the temptation to confuse *Fastchip* with *Fast Chip,* the disk drive upgrade chip from Binary Corporation. This product will interest Atari owners with original 810 disk drives, as it provides a disk format 30% faster than the original. The company claims that the custom chip is 10% faster than even the new Atari upgrade chip.

It took about a half an hour for me to perform the upgrade, and was a bit more involved than I had initially anticipated. Still, the instructions are clear, and the process is broken into logical steps.

Binary Fast Chip without a doubt provides a faster format for your disks. I found that it cut about twenty seconds off the load time of a 12K file. But the disks are also rather sensitive —cases arose wherein *Fast Chip*-formatted disks took much *longer* to read or write. This was without exception true with disks for use with *Valforth.* It might therefore be advisable to wait until you have two drives, then install a *Fast Chip* in one. You can then choose the format to match the application.

The product lists for $39.95. For more information, contact Binary Corporation, 3237 Woodward Ave., Berkley, MI 48072.

Perhaps you've wondered if ROM cartridges could be copied to disk. Well they can now, with the *Block* from Protronics. The *Block* allows you to transfer from a ROM to a binary disk file. Up to ten ROM cartridges can be saved to a single disk. I was unable to find anything that the *Block* couldn't copy.

Potential pirates should take note: the *Block* itself is a ROM cartridge, and no cartridge file will run unless the *Block* is installed.

The *Block* lists for $99.95. For more information, contact Protronics, 17537 Chatsworth, Granada Hills, CA 91344.

The Library Grows

I remember, in the dim recesses of my mind, a time when information about the Atari was an extremely rare commodity. This was in ancient times, of course: maybe a year and a half ago. Now it seems a new book about the Atari arrives here every week. These are six of the best:

Atari Games and Recreations, by Herb Kohl, Ted Kahn, Len Lindsay, and Pat Cleland, Reston Publishing, Reston, VA 22090. Excellent starter for novices and kids, with an emphasis on fun programs the user can type in, play, and understand. Includes some nifty appendices.

Atari Sound and Graphics, by Herb Moore, Judy Lower, and Bob Albrecht, John Wiley and Sons, 605 Third Avenue, New York, NY 10158. The authors pace the text so that new concepts are introduced at a rate that can be absorbed. Sound and graphics

Figure 3.

```
110 REM A PRACTICAL DEMONSTRATION
120 DIM A$(10),N$(20),P$(18)
130 GRAPHICS 0
140 ? "**************************"
150 ? "*                        *"
160 ? "*  TELEPHONE DIRECTORY    *"
170 ? "*                        *"
180 ? "*         (L)IST         *"
190 ? "*         (A)DD          *"
200 ? "*         (D)ELETE       *"
210 ? "*         (S)AVE         *"
220 ? "*                        *"
230 ? "**************************"
240 INPUT A$:TRAP 130
250 IF A$(1,1)="A" THEN 300
260 IF A$(1,1)="D" THEN 360
270 IF A$(1,1)="S" THEN SAVE "D:DIRECTORY":REM CASSETTE USERS "CSAVE"
280 LIST 1,100
290 ? "PRESS RETURN TO CONTINUE":INPUT A$:GOTO 130
300 ? "WHAT WILL BE THE LISTING NUMBER";:INPUT N
310 ? "NAME";:INPUT N$:? "PHONE NUMBER";:INPUT P$:TRAP 310
320 GRAPHICS 0:POSITION 2,2
330 ? N;" REM",N$;" ";P$:? "CONT"
340 POSITION 2,0:POKE 842,13:STOP
350 POKE 842,12:GOTO 130
360 ? "LISTING NUMBER TO DELETE";:INPUT N:TRAP 360
370 GRAPHICS 0:POSITION 2,2
380 ? N:? "CONT"
390 POSITION 2,0:POKE 842,13:STOP
400 POKE 842,12:GOTO 130
```

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are a motivating force with kids, but many hobbyists will want this one too.

The Atari Assembler, by Don Inman and Kurt Inman, Reston Publishing, Reston, VA 22090. Best beginners machine language book available for Atari owners. Assumes you have Basic and an editor/assembler. Assembly language is tough stuff, but authors manage to keep things fresh with humor and good examples.

Games for the Atari, by S. Roberts, W. Hofacker, 53 Redrock Lane, Pomona, CA 91766. Includes good examples of player/missile movement from Basic, priority detection, and patching from Basic to machine language subroutines. Includes ten games to be typed in, unfortunately without much explanation.

Picture This, by David D. Thornburg, Addison-Wesley, Reading, MA 01867. A kid's introduction to graphics through Atari Pilot. Excellent as a supplement to "Student Pilot," the reference guide supplied with the Pilot cartridge.

Your Atari Computer, by Lon Poole, Martin McNiff, and Steven Cook, Osborne McGraw-Hill, 630 Bancroft Way, Berkeley, CA 94710. It may have taken two and a half years, but there is finally a manual available which thoroughly documents the rudiments, as well as a number of advanced topics, concerning Atari personal computers.

Following a remarkably steady pace, the book progresses through beginning operation, getting started in Basic programming, and includes comprehensive chapters on the program recorder, disk drive, and printers.

The main body of the book deals with advanced Basic programming, and stands to serve the proficient Basic programmer as well as the novice.

Next the book focuses on the goodies. Graphics and sound are given a clear and thorough treatment — with a chapter devoted to advanced graphics techniques. Character set animation, display lists and player-missile graphics are explained simply and thoroughly, with examples helping to illuminate the way. Those of you (like myself) who need every last thing spelled out for you, are bound to benefit from this approach.

Later chapters examine sound routines and summarize Basic commands.

The book concludes with nine appendices, each of value to the Atari programmer. Finally we can turn to a single resource for an annotated list of error codes and their meanings, status and keyboard codes, memory usage charts, and a listing of important memory locations.

Your Atari Computer should be packed with each and every unit Atari ships, alongside or in lieu of current documentation. No Atari owner should be without it.

Scuttlebytes

In the November issue, we gave a phone number for a Sunnyvale bulletin board system called TEAM Atari. Begun by an Atari employee, the board is unfortunately no longer in service. Apparently some Atari execs felt it was inappropriate, which is too bad.

You might try Bay Area Atari at (408) 244-6229. Sorry if we caused any inconvenience, but it is tough to compile a BBS list that remains totally accurate for any length of time.

A question many people are asking concerns the new Atari *5200* video system: is it or isn't it a *400* without a keyboard? The answer: well, yes and no. It does have 6502, Antic, GTIA, and Pokey chips. It does run nearly identical ROM software. However, for reasons somewhat difficult to fathom, the *5200* has had enough changes made to ensure incompatibility with Atari computers. The most dramatic evidence of this is a redesigned game controller, which uses an analog input, in addition to a telephone-style keypad.

The advantages to a handheld keypad are obvious: the advantages of an analog joystick perhaps less so. A potentiometer-controlled stick allows for better control in games such as *Missile Command,* but a digital stick is faster in quick-turning games like *Pac-Man.* The *5200* controller ports are necessarily redesigned, as are the cartridges themselves. Whether this incompatibility is utterly surmountible remains to be seen, but it certainly would be a formidable task.

Another topic we hear a lot about is the "next generation" Atari. Have you heard about the Atari *600?* We have, although we haven't been able to confirm anything. It will be a single board computer, totally compatible with the *400* and *800.* It will have RS-232 capability built-in, and a full-stroke keyboard. It will come with 48K standard, and sport programmable function keys. We have even heard about an Atari *1000,* with a built-in dual density drive, and CP/M capability!

Smalltalk

What, you may ask, has become of Dave and Sandy Small? They are responsible for some of the most informative articles concerning the Atari that have ever appeared in any magazine. I first learned about player/missile graphics, display lists, redefinable character sets, and a half dozen other topics from their series of articles, which began in the June, 1981, issue of *Creative Computing.*

Well Dave was unhappy with the speed of the 810 disk drive, and so he did something about it: he designed his own. His system is aimed at professionals, and in addition to its many other capabilities, is about seven times faster than an 810 drive. If you'd like more information concerning the system, you can contact Dave at the Leading Edge, 8642A Spicewood Springs Road, P.O. Box 10998, Austin, TX 78766.

All of us at *Creative Computing* wish you the best this holiday season, and a happy, healthy new year. And to all a good night! □

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The Graph Paper

Part 6: The Power

David Lubar

This is where the fun begins. That mysterious mid-memory chunk of hi-res graphics becomes clay which we can mold to fit any whim. I could ramble on about the great feeling derived from taking full control of the screen, but will avoid proselytizing and instead pass on an example. Granted, every programmer tends to preach his favorite language, be it Assembly, Forth, Pascal, or whatever; still, the following example should convince unbelievers that machine language is the only way to go.

Listing 1 shows a Basic program that fills the hi-res screen in sequence with values from 0 to 255. Listing 2 does the same thing in machine language. I will discuss this second program in detail later. For now, try them both and savor the difference. Awesome, isn't it? O.K., I've vented my preaching for the month. From here on down I'll try to refrain.

This month's prize-winning question, from Chris Pedonesi, pretty much encompasses all the material covered below. He wants to know "how the memory in the hi-res graphics pages are related to the display, and how to use this information to draw shapes and characters on the screen directly." It will take more than one article to cover this topic, so let's get started.

Bit Maps

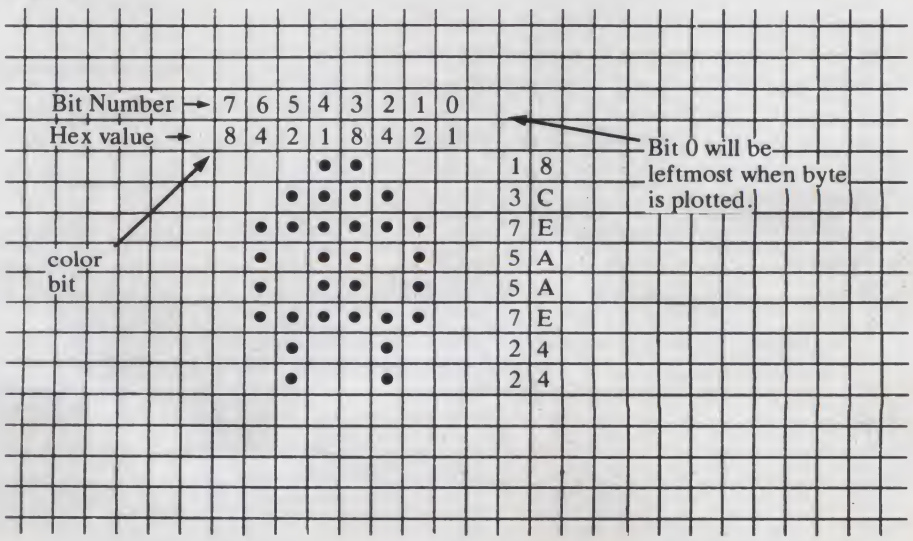
There are two components to hi-res graphics: the memory map and the bytes within the map. Once you understand these two things, you have it licked. The memory map for hi-res comprises locations $2000 to $3FFF. Whenever graphics is enabled, the video image produced by the Apple is based on the values found in this area.

The hi bit of each byte determines which color group to display for that byte. The remaining bits determine whether or not to plot a pixel. So each byte controls seven dots on the screen. These bits are displayed in what seems to be a backwards fashion.

The lowest bit of each byte plots the left-most pixel of the set, the highest plotting bit plots the rightmost pixel. The best way to see this is with an example. First, get into the monitor. From here, typing $C050 (return) $C054 (return) $C057 (return) will put up the graphics page.

(Weird happenings department: When you type in a memory location and press return, the Apple does two things. First, it reads and displays the value in that location. This is what toggles the soft switches to turn on graphics, etc. Second, it sets monitor pointers to the next mem-

Figure 1.



ory location. Pressing return again will produce a read and display of more bytes. This innocent feature can produce an annoying result. Let's say you typed $C050 (return) to set the graphics mode. If you next hit return again, the Apple will read $C051 and reset the text mode. Thus an innocent return can pop you into places you didn't expect. The quickest cure is to type 00 (return) after accessing graphics switches. This gets the monitor pointers safely away from the soft switches.)

Listing 1.

```
10  REM  PROGRAM TO FILL THE HI-R
    ES SCREEN
20  HGR
30  POKE 49234,0: REM  FULL SCREE
    N
40 FILL = 1
50  FOR I = 8192 TO 16383: POKE I
    ,FILL: NEXT I
60 FILL = FILL + 1: IF FILL > 256
     THEN FILL = 0
70  GOTO 50
```

Depending on what was in memory, you will be greeted with either a blank screen or some patterned or random display. To clear things up, the following trick is handy. Type 2000:00 (from here on, return is assumed unless otherwise noted). This puts the value $00 into location $2000. Now, we'll use the monitor MOVE command to trick the Apple into filling the rest of the screen area with that same $00.

The memory move feature of the monitor normally operates by taking each byte of the source and moving it to the destination. By placing the destination area within the source area, the Apple can be made to fill memory with any value. In this instance, the command is 2001<2000.3FFEM.

You have just told the Apple to move into the area starting at location $2001 everything from $2000 to $3FFE. First, it takes the value from $2000 (which we set to $00) and places it in $2001. Next, it takes the value from $2001 and places it in $2002. Thus, the original value propagates throughout the desired range.

Anyhow, to see the way bytes are interpreted graphically, try placing different values in location $2000. Start with 2000:01. One pixel will light up. Change the number to $02. The pixel will move to the right. The hex values 01,02,04,08,10, 20,40 in sequence turn on each bit of the byte in order from left to right. Isolated bits are in color.

You will notice that as the pixel moves through its seven positions, the color alternates. Bits set at an odd coordinate produce one color, those on an even coordinate produce the other color. Any two bits in a row will be white. If the high bit is set (by adding $80 to the byte), the other color group will be produced.

To put up any specific pattern of seven bits, you merely change the pattern into ones and zeroes, then convert this binary value to hex. That's all there is to it.

Suppose you want a line of two colored bits at the leftmost part of the screen. Remembering that the lowest bit plots the leftmost pixel, and that solid color is obtained by alternate bits, the pattern would be 00000101 or $05. To get the other color set, use $85. For the other two colors, shift the pattern by one bit so it becomes 00001010 or $0C.

One of the problems you will encounter is due to the fact that 7 is an odd number (I'm not sure who discovered this profound mathematical tidbit). To get a graphic idea of what the problem is, enter the following 2000:01 01. This puts the value $01 into locations $2000 and $2001.

Notice that the two pixels are not the same color. Since the Apple displays one set of colors at even locations and another set at odd locations, and since there are seven bits plotted for each byte, as any byte is moved through screen memory, its bits alternate between having even and odd positions.

If you place $01 in location $2000, the set bit occurs at horizontal location 0. Move the byte to $2001 and the set bit lights up a pixel at location 7. Move to $2002 and the bit is even again and lighting up location 14. This won't affect us much right now, but will come into play a great deal as we progress.

The simplest graphic manipulations are those, such as Listing 1, which access the whole screen. In such cases, the screen can be treated as *nothing* more than an 8K block of memory. The next step is to access the screen in order, line by line. Unfortunately, memory order and screen order do not coincide. We'll explore that soon enough. For now, let's go through some simple manipulations.

Listing 2.

```
:ASM
                        1     * PROGRAM TO FILL THE
                        2     * HI-RES SCREEN WITH
                        3     * A SEQUENCE OF VALUES
                        4     *
                        5               ORG   $6000
                        6     BYTE      EQU   $F8
                        7     DESTLO    EQU   $F9
                        8     DESTHI    EQU   $FA
                        9     *
                        10    * INITIALIZE THE SCREEN
                        11    *
6000: 8D 50 C0          12              STA   $C050   ;GRAPHICS MODE
6003: 8D 52 C0          13              STA   $C052   ;FULL SCREEN
6006: 8D 54 C0          14              STA   $C054   ;PAGE 1
6009: 8D 57 C0          15              STA   $C057   ;HI-RES
                        16    *
                        17    * SET UP POINTERS AND COUNTERS
                        18    *
600C: A9 00             19              LDA   #$00    ;INITIALIZE VALUE THAT WILL
600E: 85 F8             20              STA   BYTE    ;BE STORED TO THE SCREEN
6010: A8                21              TAY
6011: 85 F9             22              STA   DESTLO
6013: A9 20             23    LOOP      LDA   #$20
6015: 85 FA             24              STA   DESTHI  ;SET POINTER TO $2000
6017: AA                25              TAX           ;X IS USED TO COUNT $20 PAGES
6018: A5 F8             26              LDA   BYTE    ;RESTORE DESIRED SCREEN BYTE
601A: 91 F9             27    LOOP1     STA   (DESTLO),Y
601C: C8                28              INY
601D: D0 FB             29              BNE   LOOP1   ;DO ONE PAGE
601F: E6 FA             30              INC   DESTHI  ;POINT TO NEXT PAGE
6021: CA                31              DEX           ;DECREASE COUNTER
6022: D0 F6             32              BNE   LOOP1   ;DO $20 PAGES
                        33    *
                        34    * SCREEN HAS BEEN FILLED.
                        35    * *
6024: E6 F8             36              INC   BYTE    ;SET UP NEXT VALUE
6026: A9 FF             37              LDA   #$FF    ;DELAY A BIT
6028: 20 A8 FC          38              JSR   $FCA8   ;USING MONITOR ROUTINE
602B: AD 00 C0          39              LDA   $C000   ;CHECK FOR KEYPRESS
602E: 10 E3             40              BPL   LOOP    ;NO KEY
6030: 2C 10 C0          41              BIT   $C010   ;CLEAR KEYBOARD
6033: 8D 51 C0          42              STA   $C051   ;RESTORE TEXT MODE
6036: 60                43              RTS

--- END ASSEMBLY ---

TOTAL ERRORS: 0

55 BYTES GENERATED THIS ASSEMBLY
```

Massive Changes

Listing 1 is a typical example of simple screen manipulation. It first sets up a

pointer to location $2000. I have used a few standard shortcuts in the code which are mostly a matter of preference rather than any hard and fast rules.

For example, LDY #$00 could have been used instead of TYA. But since the zero was already in the accumulator, the TYA operation saves space.

The use of the X register as a counter is another shortcut. In this case, I know I am dealing with $20 pages of memory, so it is convenient to move the $20 into X and use that register as a counter. Another method would be to check the hi byte of the pointer after each increment and stop when it reached $40.

Anyhow, working through one page (256 bytes) at a time, the program places a byte (initially zero) in screen memory. The command STA (DESTLO),Y is an example of indirection, a common technique that is used extensively in graphics. The memory location within the parentheses points to the actual location used by the operation.

At the start, DESTLO and DESTHI point to location $2000. The value in the Y register is added to this. If Y contains 5, the command operates on location $2005. In general, this method is very handy for stepping through a page of memory. The only drawback is that such commands are slower than those that do not use indirection. While a difference of one machine cycle is not crucial now, you will encounter cases in which the slight delay, compounded by a looping structure, might cause noticeable delays in a program.

Listing 3.

```
:ASM
                        1     * PROGRAM TO PRODUCE
                        2     * A 'NEGATIVE' SCREEN IMAGE
                        3     *
                        4             ORG   $6000
                        5     DESTLO  EQU   $F8
                        6     DESTHI  EQU   $F9
                        7     *
6000: 8D 50 C0          8             STA   $C050
6003: 8D 52 C0          9             STA   $C052
6006: 8D 54 C0          10            STA   $C054
6009: 8D 57 C0          11            STA   $C057
600C: A9 00             12            LDA   #$00
600E: A8                13            TAY
600F: 85 F8             14            STA   DESTLO
6011: A9 20             15            LDA   #$20
6013: 85 F9             16            STA   DESTHI
6015: AA                17            TAX
6016: B1 F8             18    LOOP    LDA   (DESTLO),Y
6018: 49 FF             19            EOR   #$FF
601A: 91 F8             20            STA   (DESTLO),Y
601C: C8                21            INY
601D: D0 F7             22            BNE   LOOP
601F: E6 F9             23            INC   DESTHI
6021: CA                24            DEX
6022: D0 F2             25            BNE   LOOP
6024: 60                26            RTS

--- END ASSEMBLY ---

TOTAL ERRORS: 0

37 BYTES GENERATED THIS ASSEMBLY
```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CIRCLE 223 ON READER SERVICE CARD

While filling the screen is fun for a bit, it does seem to be a rather limited program. But it is a step in the right direction. With a slight modification, things become more interesting.

Rather than just store a value into each location, let's modify existing values. Put your favorite picture on the screen, then try the program in Listing 3. This one produces a "negative" of the screen image.

The basic setup is the same. The difference is that the program reads each screen byte, performs an exclusive or with $FF, then stores the result. By using various logical operations, you can produce different interesting effects. Since logical operations are one of the keys to graphics, it will be worthwhile to take a short sidetrip through the topic.

A Bit At A Time

The three logical operations, AND, ORA, and EOR, have a rather beautiful symmetry. Each can either change a bit in a certain way or leave it alone, depending on the values used. Rather than go through truth tables, let's look at the situation in a practical way.

There are three things you might want to do to a bit; force it to be 1, force it to be 0, or flip it (making 1 into 0 or 0 into 1). ORA can force a bit to be 1. Wherever there is a 1 in the operand, there will be a 1 in the results. Where there is a 0, there will be no effect.

Let's say you want to set the hi bit of each byte on the screen. This, plugged into Listing 3, would be done with ORA #$80 (remember that $80 is 10000000 in binary). The hi bit of each byte will be set to 1, no matter what it was before. The rest of the bits will be unchanged.

To force a 0, use AND. Any bit set to 0 in the operand will produce 0 in the results. A value of 1 leaves the result unchanged. Following the above example, we can set all the hi bits to 0 using AND #7F (again $7F is binary 01111111).

Finally, EOR is used to flip a bit. A 1 in the operand will flip a bit, a 0 has no result. So, the EOR #$FF in Listing 3 flips all the bits in each byte. If you wanted to flip everything except for the hi bit, you would use EOR #$7F.

Sometimes a combination of operations is necessary. If you wanted to produce a negative of the screen and set all hi bits to 0, you would use EOR #$FF followed by AND #$7F. Try some combinations on a picture and see if you can predict the results. What would AND #$0F do? What happens if you EOR a screen byte with itself?

Order, Please

Here comes the big one. The toughest obstacle to doing Apple graphics is that the screen is not mapped in contiguous fashion. The first 40 screen bytes occur normally enough in locations $2000 to $2027. But if you put a byte into $2028, it won't appear on the second line. Strange as it may seem, the address of the first byte of the second line is $2400. The third line starts with $2800.

I don't know the exact reason for this mapping, but it basically ties in with the video hardware and the fact that the screen has 40 bytes across and (another staggering mathematical discovery) 40 does not go evenly into 256. Anyhow, this is the mapping we have to live with.

The pattern is actually not that bizarre. Starting at $2000, each successive line is found by adding $400 (or adding $04 to the hi byte). After reaching $3C00, the sequence goes to $2080 and again begins adding $400. After $3C80 comes $2100. So far the pattern seems to be; add $400 for each successive line until the number becomes too large. Then add $80. Then go back to adding $400 again.

Listing 4.

```
6100- 20 24 28 2C 30 34 38 3C
6108- 20 24 28 2C 30 34 38 3C
6110- 21 25 29 2D 31 35 39 3D
6118- 21 25 29 2D 31 35 39 3D
6120- 22 26 2A 2E 32 36 3A 3E
6128- 22 26 2A 2E 32 36 3A 3E
6130- 23 27 2B 2F 33 37 3B 3F
6138- 23 27 2B 2F 33 37 3B 3F
6140- 20 24 28 2C 30 34 38 3C
6148- 20 24 28 2C 30 34 38 3C
6150- 21 25 29 2D 31 35 39 3D
6158- 21 25 29 2D 31 35 39 3D
6160- 22 26 2A 2E 32 36 3A 3E
6168- 22 26 2A 2E 32 36 3A 3E
6170- 23 27 2B 2F 33 37 3B 3F
6178- 23 27 2B 2F 33 37 3B 3F
6180- 20 24 28 2C 30 34 38 3C
6188- 20 24 28 2C 30 34 38 3C
6190- 21 25 29 2D 31 35 39 3D
6198- 21 25 29 2D 31 35 39 3D
61A0- 22 26 2A 2E 32 36 3A 3E
61A8- 22 26 2A 2E 32 36 3A 3E
61B0- 23 27 2B 2F 33 37 3B 3F   Hi bytes
61B8- 23 27 2B 2F 33 37 3B 3F
61C0- 00 00 00 00 00 00 00 00   Lo bytes
61C8- 80 80 80 80 80 80 80 80
61D0- 00 00 00 00 00 00 00 00
61D8- 80 80 80 80 80 80 80 80
61E0- 00 00 00 00 00 00 00 00
61E8- 80 80 80 80 80 80 80 80
61F0- 00 00 00 00 00 00 00 00
61F8- 80 80 80 80 80 80 80 80
6200- 28 28 28 28 28 28 28 28
6208- A8 A8 A8 A8 A8 A8 A8 A8
6210- 28 28 28 28 28 28 28 28
6218- A8 A8 A8 A8 A8 A8 A8 A8
6220- 28 28 28 28 28 28 28 28
6228- A8 A8 A8 A8 A8 A8 A8 A8
6230- 28 28 28 28 28 28 28 28
6238- A8 A8 A8 A8 A8 A8 A8 A8
6240- 50 50 50 50 50 50 50 50
6248- D0 D0 D0 D0 D0 D0 D0 D0
6250- 50 50 50 50 50 50 50 50
6258- D0 D0 D0 D0 D0 D0 D0 D0
6260- 50 50 50 50 50 50 50 50
6268- D0 D0 D0 D0 D0 D0 D0 D0
6270- 50 50 50 50 50 50 50 50
6278- D0 D0 D0 D0 D0 D0 D0 D0
```

Listing 5.

```
:ASM
                        1     * PROGRAM TO PRODUCE
                        2     * A 'NEGATIVE' SCREEN IMAGE
                        3     *
                        4             ORG   $6000
                        5     DESTLO  EQU   $F8
                        6     DESTHI  EQU   $F9
                        7     TABHI   EQU   $6100
                        8     TABLO   EQU   $61C0
                        9     *
                        10    * NOTE: LOOKUP TABLE IS NOT INCLUDED
                        11    * IN THIS FILE. IT MUST BE
                        12    * BLOADED SEPARATELY.
                        13    *
                        14    *
6000: 8D 50 C0          15            STA   $C050
6003: 8D 52 C0          16            STA   $C052
6006: 8D 54 C0          17            STA   $C054
6009: 8D 57 C0          18            STA   $C057
600C: A2 00             19            LDX   #$00    ;USE X TO INDEX TABLE
600E: BD C0 61          20    LOOP1   LDA   TABLO,X ;SET UP POINTERS
6011: 85 F8             21            STA   DESTLO
6013: BD 00 61          22            LDA   TABHI,X
6016: 85 F9             23            STA   DESTHI
6018: A0 27             24            LDY   #$27    ; PREPARE TO DO A LINE
601A: B1 F8             25    LOOP2   LDA   (DESTLO),Y ; GET SCREEN BYTE
601C: 49 FF             26            EOR   #$FF    ;FLIP IT
601E: 91 F8             27            STA   (DESTLO),Y ;PUT IT BACK
6020: 88                28            DEY
6021: 10 F7             29            BPL   LOOP2   ;REPEAT FORTY TIMES
6023: E8                30            INX
6024: E0 C0             31            CPX   #$C0    ;DO 192 LINES
6026: D0 E6             32            BNE   LOOP1
6028: 60                33            RTS

--- END ASSEMBLY ---

TOTAL ERRORS: 0

41 BYTES GENERATED THIS ASSEMBLY
```

Eventually, you will reach $3F80. The next number is $2028. The sequence now goes through $2428 and so on. Now the low bytes alternate between $28 and $A8. After this series taps out, the lo bytes become $50 and $D0. Finally, the last line starts at $3FD0.

If you have followed this pattern you might have noticed that there are 16 unused bytes on each page. These occur from $78 to $7F and $F8 to $FF for each page of hi-res memory.

In the old days, programmers used a calculation method to find the starting address of the line. The current method is to use a lookup table. This table contains the starting address of each line of the screen in order. The table requires 192 each for lo bytes and hi, or two entries for each line of the screen.

While it is a bit tedious to type in the table, it will be used in almost any graphics program you write. I would suggest saving a copy, either as a binary file or as a set of assembler data statements, then just patching it into future programs.

Rather than repeat the whole table in all programs that require it, I shall list it once here, and just refer to it in future programs. For a hex dump of the lookup table, see Listing 4.

Sequential access of the screen can be applied to Listing 3. Rather than change the picture in interleaved fashion, we can do it smoothly from top to bottom. Listing 5 shows the program.

The lookup table, combined with indirect addressing, allows us to access any part of the screen selectively. If you can access a specific area of the screen, and put what you want on that area, you are a good way toward full animation. Since there are a few additional concepts needed for smooth animation, let's stick with the byte level for the moment and look at character graphics.

Cast of Characters

As a first taste, get into the monitor, clear the screen, and type the sequence shown in Listing 6. In a slow fashion, you have just performed a feat of character graphics. That's all the computer does; it takes a series of bytes and puts them on the screen.

Listing 6.

```
2000:18
2400:3C
2800:7E
2C00:5A
3000:5A
3400:7E
3800:24
3C00:24
```

The bytes come from a shape table, but it is unlike an Applesoft shape table. The shape tables we will be using from now on are bit mapped images of the

Listing 7.

```
:ASM
                        1    * EXAMPLE OF SIMPLE
                        2    * CHARACTER GRAPHICS
                        3    *
                        4            ORG  $6000
                        5    DESTLO  EQU  $F8
                        6    DESTHI  EQU  $F9
                        7    XLOC    EQU  $FA
                        8    YLOC    EQU  $FB
                        9    OLDX    EQU  $FC
                        10   OLDY    EQU  $FD
                        11   OLDKEY  EQU  $FE
                        12   TEMP    EQU  $FF
                        13   TABHI   EQU  $6100
                        14   TABLO   EQU  $61C0
                        15   *
                        16   * NOTE: LOOKUP TABLE IS NOT INCLUDED
                        17   * IN THIS FILE. IT MUST BE
                        18   * BLOADED SEPARATELY.
                        19   *
                        20   * CLEAR SCREEN
                        21   *
6000: A9 20             22           LDA  #$20
6002: 85 F9             23           STA  DESTHI
6004: AA                24           TAX
6005: A9 00             25           LDA  #$00
6007: 85 F8             26           STA  DESTLO
6009: A8                27           TAY
600A: 91 F8             28   CLEAR   STA  (DESTLO),Y
600C: C8                29           INY
600D: D0 FB             30           BNE  CLEAR
600F: E6 F9             31           INC  DESTHI
6011: CA                32           DEX
6012: D0 F6             33           BNE  CLEAR
                        34   *
                        35   * ENABLE GRAPHICS
                        36   *
6014: 8D 50 C0          37           STA  $C050
6017: 8D 52 C0          38           STA  $C052
601A: 8D 54 C0          39           STA  $C054
601D: 8D 57 C0          40           STA  $C057
                        41   *
                        42   * INITIALIZE VARIABLES
                        43   *
6020: A9 13             44           LDA  #$13
6022: 85 FA             45           STA  XLOC
6024: 85 FC             46           STA  OLDX
6026: A9 60             47           LDA  #$60
6028: 85 FB             48           STA  YLOC
602A: 85 FD             49           STA  OLDY
                        50   *
                        51   * ERASE/REDRAW CYCLE FOLLOWS.
                        52   * FIRST TIME THROUGH, ERASE COULD
                        53   * BE SKIPPED.
                        54   *
602C: A2 07             55   ERASE   LDX  #$07   ;SHAPE HAS 8 BYTES
602E: A4 FD             56           LDY  OLDY   ;GET VERTICAL ADDRESS
6030: 84 FF             57           STY  TEMP
6032: B9 C0 61          58   ERASE1  LDA  TABLO,Y ;SET UP POINTERS
6035: 85 F8             59           STA  DESTLO
6037: B9 00 61          60           LDA  TABHI,Y
603A: 85 F9             61           STA  DESTHI
603C: A9 00             62           LDA  #$00
603E: A4 FC             63           LDY  OLDX   ; GET HORIZONTAL LOCATION
6040: 91 F8             64           STA  (DESTLO),Y ;ERASE A BYTE
6042: E6 FF             65           INC  TEMP
6044: A4 FF             66           LDY  TEMP   ;NEXT LINE
6046: C0 C0             67           CPY  #$C0   ;CHECK FOR END OF SCREEN
6048: F0 03             68           BEQ  DRAW
604A: CA                69           DEX
604B: 10 E5             70           BPL  ERASE1
                        71   *
604D: A2 07             72   DRAW    LDX  #$07
604F: A4 FB             73           LDY  YLOC
6051: 84 FF             74           STY  TEMP
6053: B9 C0 61          75   DRAW1   LDA  TABLO,Y
6056: 85 F8             76           STA  DESTLO
6058: B9 00 61          77           LDA  TABHI,Y
605B: 85 F9             78           STA  DESTHI
605D: BD E6 60          79           LDA  SHAPE,X ;GET A BYTE OF THE SHAPE
6060: A4 FA             80           LDY  XLOC
6062: 91 F8             81           STA  (DESTLO),Y ;PUT BYTE ON SCREEN
6064: E6 FF             82           INC  TEMP
6066: A4 FF             83           LDY  TEMP
```

```
6068: C0 C0     84              CPY  #$C0
606A: F0 0B     85              BEQ  READKEY
606C: CA        86              DEX
606D: 10 E4     87              BPL  DRAW1
606F: A5 FA     88              LDA  XLOC
6071: 85 FC     89              STA  OLDX
6073: A5 FB     90              LDA  YLOC
6075: 85 FD     91              STA  OLDY
                92   *
                93   * SHAPE HAS BEEN DRAWN.
                94   * TIME TO CHECK KEYBOARD AND
                95   * ADJUST LOCATION.
                96   *
6077: AD 00 C0  97   READKEY  LDA  $C000  ;CHECK KEYBOARD
607A: 30 02     98              BMI  FOUNDKEY ;IF MINUS, KEY HAS BEEN PRESSED
607C: A5 FE     99              LDA  OLDKEY ;USE LAST VALID VALUE
607E: C9 C1     100  FOUNDKEY CMP  #$C1   ;A
6080: F0 17     101             BEQ  UP
6082: C9 DA     102             CMP  #$DA   ;Z
6084: F0 23     103             BEQ  DOWN
6086: C9 88     104             CMP  #$88   ;LEFT ARROW
6088: F0 2F     105             BEQ  LEFT
608A: C9 95     106             CMP  #$95   ;RIGHT ARROW
608C: F0 37     107             BEQ  RIGHT
608E: C9 A0     108             CMP  #$A0   ;SPACE
6090: F0 4A     109             BEQ  PAUSE
6092: C9 9B     110             CMP  #$9B   ;ESCAPE
6094: F0 3F     111             BEQ  GETOUT
                112  *
                113  * NO VALID KEY HAS BEEN FOUND
                114  *
6096: 4C DE 60  115             JMP  KEYDONE
                116  *
                117  * ROUTINES TO HANDLE THE
                118  * VARIOUS KEYBOARD ENTRIES
                119  *
6099: 85 FE     120  UP         STA  OLDKEY
609B: C6 FB     121             DEC  YLOC   ;TOP IS 0 SO USE DEC TO MOVE UP
609D: A5 FB     122             LDA  YLOC
609F: C9 FF     123             CMP  #$FF   ;CHECK FOR WRAPAROUND
60A1: D0 3B     124             BNE  KEYDONE
60A3: A9 BF     125             LDA  #$BF
60A5: 85 FB     126             STA  YLOC
60A7: 30 35     127             BMI  KEYDONE ;ALWAYS TAKEN
60A9: 85 FE     128  DOWN       STA  OLDKEY
60AB: E6 FB     129             INC  YLOC
60AD: A5 FB     130             LDA  YLOC
60AF: C9 C0     131             CMP  #$C0
60B1: D0 2B     132             BNE  KEYDONE
60B3: A9 00     133             LDA  #$00
60B5: 85 FB     134             STA  YLOC
60B7: F0 25     135             BEQ  KEYDONE
60B9: 85 FE     136  LEFT       STA  OLDKEY
60BB: C6 FA     137             DEC  XLOC
60BD: 10 1F     138             BPL  KEYDONE
60BF: A9 27     139             LDA  #$27
60C1: 85 FA     140             STA  XLOC
60C3: D0 19     141             BNE  KEYDONE
60C5: 85 FE     142  RIGHT      STA  OLDKEY
60C7: E6 FA     143             INC  XLOC
60C9: A5 FA     144             LDA  XLOC
60CB: C9 28     145             CMP  #$28
60CD: D0 0F     146             BNE  KEYDONE
60CF: A9 00     147             LDA  #$00
60D1: 85 FA     148             STA  XLOC
60D3: F0 09     149             BEQ  KEYDONE
60D5: 2C 10 C0  150  GETOUT     BIT  $C010
60D8: BD 51 C0  151             STA  $C051  ;RESTORE TEXT
60DB: 60        152             RTS
60DC: 85 FE     153  PAUSE      STA  OLDKEY
                154  * DELAY FOR A WHILE, THEN JUMP BACK
                155  *
60DE: A9 80     156  KEYDONE   LDA  #$80   ;TRY DIFFERENT VALUES HERE
60E0: 20 A8 FC  157             JSR  $FCA8  ;MONITOR DELAY ROUTINE
60E3: 4C 2C 60  158             JMP  ERASE
                159  *
                160  * SHAPE DEFINITION FOLLOWS.
                161  * IT IS STORED UPSIDE DOWN SINCE
                162  * IT IS INDEXED FROM BYTE 7 TO
                163  * BYTE 0.
                164  *
60E6: 00 41 49  165  SHAPE      HEX  0041495D7F5D4941

--- END ASSEMBLY ---

TOTAL ERRORS: 0

238 BYTES GENERATED THIS ASSEMBLY
```

desired shape. The best way to construct such a table, for now, is to use graph paper. See Figure 1 for an example.

For simple character graphics, the figure is one byte wide and eight bytes deep. This is by no means a requirement, but will help keep things simple for the moment. The bytes are placed sequentially in a table and looked up in order.

Character graphics can be used for doing simple animation and for placing text on the graphics screen. For an introduction, see Listing 7. This program moves a character on the screen under keyboard control. Use A and Z to move up and down, the arrow keys to move left and right. The space bar can be used to stop the motion and escape exits the program.

The program isn't actually a pure example of character graphics, since while the shape moves a byte at a time horizontally, it moves a single line at a time vertically.

Try playing with the delay value to produce the smoothest image. You will notice that the color problem created by odd and even positions is evident in this program. We'll look at that, go into further depth on character graphics, and look at other methods of screen manipulation next month.

Other Stuff

Again, I must thank those who wrote with questions or comments. Due to the nature of magazine schedules, this article is being written several months before it will be published. So, if you send a question this month, there's a chance the answer is covered in next month's article which, by the time you read this, will already have been written. (In other words, those of us involved with this sort of temporal madness have a hard time even telling what month it is.) But there are probably some things I have either missed or glossed over, so some answers will be appearing a bit out of order.

When necessary, I will devote some space to backtracking and answering questions that reached me after the topic was covered. A few readers have asked about the prize given each month, wondering exactly what *Shape Master* is. In answer, it is a program from *Creative Computing* for developing shape tables.

Several people have asked if I could review the various graphics packages that are on the market. While I appreciate such requests, my present position precludes such work. I'm sure such areas will be well covered by others.

Finally, you may have noticed that there has been no mention of Pascal or of graphics tablets in these articles. These are two areas with which I really don't have much experience, and will again have to leave to others.

That's all for this month. □

images...ibm images...ibm ima

Will Fastie

Stay with me now — it's time for another time warp.

This is the Christmas issue of *Creative* which you have received in November, before Thanksgiving. I am writing this column in late August (my editor is holding her breath — I'm too close to the deadline, as usual). So for you, Christmas season is in progress (on TV, in toy stores, etc.) while for me, it is pretty far off. And it's not even Thanksgiving yet. Wait a minute, for *you* it's not Thanksgiving but for me . . . no, that's wrong, it's Christmas for me and . . . hold it, it's . . . oh forget it.

One thing is sure. It's Christmas for IBM and everyone else in the IBM game.

In a way, it *is* Christmas for me. This month's column is dedicated to my now-(in)famous mini-reviews of consumer software, so my table is heaped full of software of all descriptions, just waiting to be tried. I hope this brief tour of games and educational programs is of some value to you. I just want you to know that I have spent countless hours pouring over manuals, running the programs, and losing sleep so that you, my faithful readers, could have the best possible information. No sacrifice with these games, uh, er, that is, these consumer products, has been too great.

I have tried each of the software packages reviewed here. Many of the games have been reviewed in *Creative* and other publications before, so I didn't feel compelled to examine them in detail. I have pointed out special features, if any. Please take my comments as preliminary information, and look closely before you buy.

W. H. Fastie, 7110 Sheffield Road, Baltimore, MD 21212. Correspondence can only be acknowledged when a stamped, self-addressed envelope has been provided. Source Address: TCP394

Reference Materials

Although the IBM documentation is very good, in many ways setting a new standard, there is always something to learn. I have encountered a number of books and other sources of information which I think might prove useful.

Books

First of all, there are the books which have been written specifically about the IBM Personal Computer. One of the first is *IBM's Personal Computer* (DeVoney and Summe, Que Corporation, 1982) which provides a general look at the IBM PC. I consider this book valuable if you are considering the PC, but less so if you already own one.

Another is *IBM Personal Computer: An Introduction to Programming and Applications* (Goldstein and Goldstein, Robert J. Brady, 1982) which is a reasonable introduction to programming in Basic on the PC.

The best Basic book for novices is *Elementary Basic* (Ledgard and Singer, Vintage Books, 1982). Although the book does not specifically relate to the IBM PC or the PC dialect of Basic, it is an excellent learning vehicle.

Ledgard and Singer also have *Elementary Pascal,* which is exactly the same book for Pascal. That too is excellent. Some might think the notion of "Learning to Program Your Computer In Pascal/Basic With Sherlock Holmes" is a little cute, but the books are entertaining, as well as effective. The programs that Holmes has you writing are quite sophisticated — more than you might think should be in an introductory text and more than you might think you could handle, but you will.

IBM/PC Survivor's Manual: A Primer for the IBM Personal Computer (Mayer, Mayer Associates, 1982) is a very light and easily read tutorial which was written by John Mayer when he became frustrated with the IBM documentation. When I first read this book I wasn't impressed, but later I went back and tried to read it as though I had never seen a computer before. In that context it is quite good, defining lingo and helping the reader find his way through the IBM books. It has only 35 pages, so the price of $11.95 is somewhat high.

Finally, *Practical Basic Programs: IBM Personal Computer Edition* (Poole (ed.), Osborne/McGraw-Hill, 1982) is a rewrite of a previous work. The rewriting was primarily in the programs, which were converted to the IBM Basic. No games here: the book will appeal to a business or scientific/technical audience. It is very well done. You can determine its value to you by reading the table of contents.

I have seen two VisiCalc reference books. The first is *An Introduction to VisiCalc Matrixing for Apple and IBM* (Anbarlian, McGraw-Hill, 1982). I found it difficult to work with and a little hard to read. It contains nine matrices each for the Apple and the

IBM PC, a total of eighteen different models. If the models are of interest, the book might have some value.

A more carefully considered and constructed book is *The VisiCalc Book: Apple Edition* (Beil, Reston, 1982). Professor Beil writes that the IBM Edition is in the works and due out by now, as you read. I think the book is useful to any serious student of VisiCalc and is suitable as a self-teaching guide. This is a good one for business users, especially because of Chapter 11, "What Our Client, Secretary, or Supervisor Needs to Know: How Others Use Our Templates Successfully."

For the consumer, graphics is usually a passion. For those wishing to get all the technical details, *Fundamentals of Interactive Computer Graphics* (Foley and Van Dam, Addison-Wesley, 1982) is excellent. You can learn whatever you need to learn from this book, but be warned — it is serious stuff. A little computer science background, with above average math skills, is helpful.

A little less intimidating, but informative nonetheless, is *Microcomputer Graphics* (Myers, Addison-Wesley Microbooks, 1982). This book has a ton of programs, all for the Apple. Get it anyway: the programs can be translated to the IBM by having your buddy with the Apple tell you what the peculiar statements mean. Most are simple, like HPLOT, which can be replaced by PSET on the IBM.

Periodicals

I really do love *Creative Computing*, but it is certainly not the only place to learn about the PC. *PC: The Independent Guide to IBM Personal Computers* is devoted to the IBM system. The August issue was the best so far, helped considerably by Andrew Fluegelman. It is very slick and sexy, but in general the content could be better. But the *ads*, gad, the *ads* are great. It is like *Byte*, except that all the ads have something to do with the PC.

Then there is *Softalk for the IBM Personal Computer*, which is just getting started. I like *Softalk*, but the IBM version has a way to go before it matches the Apple version. Then there is *Personal Computer Age*, which tries hard but lacks editorial strength. Finally, *Dr. Dobb's Journal* seems to be carrying more content related to 16-bit microcomputers. For technically oriented people it is very good.

For timely information on new product releases and what is going on in general, the weekly newspaper *InfoWorld* is hard to beat. It also has regular reviews of software and hardware, which I have mostly come to respect.

And Now, The Reviews

Although it will probably mean that you will run right out to your LIBMPCD (local IBM Personal Computer Dealer) to buy some of these instead of finishing this column, I'll start the reviews with (dast I say it?) games.

First, some ground rules. Under the "system" entry in the profiles below, I have included only the most basic information, relying on your intuition to fill in the details. I have specified how much memory is required, how many disk drives are required, and which display type is needed.

The disk drive is always 160K unless otherwise specified. Display size is specified only when the width is meaningful; an entry which says either display (that is, either the IBM monochrome display, or the color/graphics adapter with a TV or other monitor) means either display at either width (80 or 40 columns). The operating system is either IBM DOS, or is not needed (for example, Microsoft *Decathalon* loads itself from disk and does not require DOS).

The "language" entry is purely informational. If Basic is required, I have only said Basic; the distinction between Advanced Basic and Disk Basic is unnecessary since owners of DOS have both anyway. Simply consult the instructions with each product. Mention of other languages, for example C, provides the more technical reader with some insights into performance. *Except for Basic, you do not need to own the language mentioned.*

Games

Here we go. Be careful: buying too many of these games could be dangerous to your financial health.

creative computing
SOFTWARE PROFILE

Name: Microsoft Decathalon
Type: Game
System: 64K IBM/PC, disk drive, color/graphics display
Format: Disk
Language: Basic
Summary: A classic
Price: $35
Manufacturer:
IBM Corporation
P.O. Box 1328
Boca Raton, FL 33432

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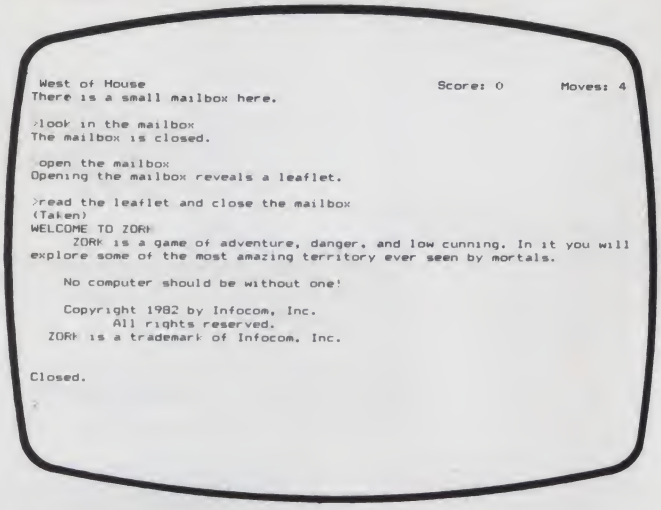
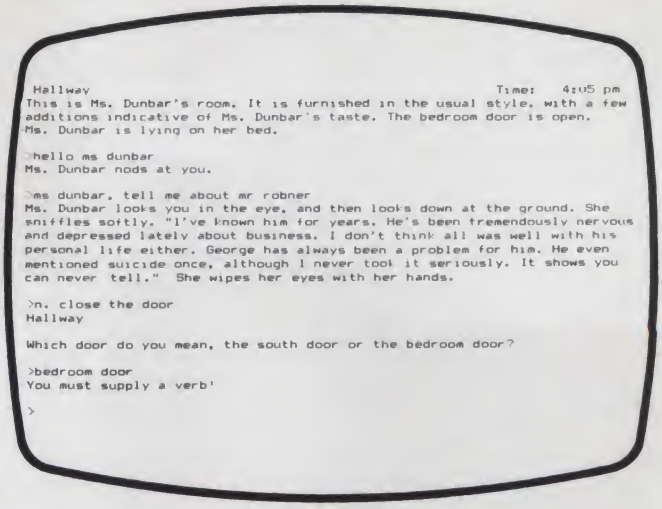


Zork.



Deadline.

Microsoft's *Olympic Decathalon* on the Apple and TRS-80 computers is a great game, and the IBM version is every bit as good. One to six players compete in the Summer Olympics marathon of 10-events, you know, the one that got Bruce Jenner's picture on a million boxes of Wheaties.

Each event is shown with superb graphics, so good that the movement in some seems real. Of all the games reviewed here, *Decathalon* was most heavily played. My wife Sandy, who is not overly fond of computer games, is hooked. On two separate occasions, guests at our home ended up in front of the computer hurling shot, javelins, and "themselves" through the air. The game induced friendly competition, and enormous fun. We discovered that three couples could easily make an evening of just playing this single game.

If you buy no other game, buy *Decathalon.* It's money well-spent.

creative computing
SOFTWARE PROFILE

Name: Zork I, Zork II
Type: Adventure game
System: 48K IBM/PC, disk drive, either display
Format: Disk
Language: Interlogic machine language
Summary: Excellent adventures
Price: $39.95
Manufacturer:
Infocom, Inc.
55 Wheeler St.
Cambridge, MA 02138

I have mentioned these games in my column before. They are just as good now as they were then. These are text adventure games. The word "text" refers to the fact that graphics are not used, so the games can be played on either the monchrome display or a display attached to the color/graphics adapter. They are fun, well-written, and challenging. Commands to the programs are given in English sentences, with the program recognizing over 600 words.

Infocom should have released two new products by the time you read this. *Zork III* completes the trilogy (is this a trilogy of trilogies guys?). *Starcross* is a new game — a science fiction adventure.

For those who want to try an adventure but who would rather not invest the 40 (?) or so hours that it takes to solve all the problems, the Zork Users Group (P.O. Box 20923, Milwaukee, WI 53220) can help. The group has a complete line of products to complement the Infocom line. Maps are available and are a big help, and ZUG has just recently announced InvisiClues. These are books with commonly asked questions about, say, *Zork I,* but they also include the answers in invisible ink. A marking pen is included and is used to reveal the answers. ZUG also has supplies for *Deadline* (see below) and will have similar products for *Zork III* and *Starcross* by the time they are out.

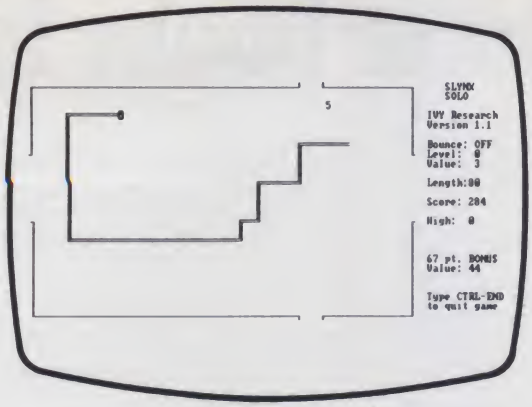
Marshall Robner is dead. The official report says it was suicide. But Mr. Robner's attorney writes you, the chief of detectives of Edindale, Connecticut, stating that he has no reason to doubt the police report except that Mr. Robner called him several days earlier to change his will. The plot thickens. Was Mr. Robner's death a suicide? Can you prove otherwise?

If you don't like the ordinary adventure game, you might like this one because it is a *real* situation, not a fantastic one. I particularly like the interaction with the characters encountered in the game during the course of play. I know of no other game that can boast such a level of realism.

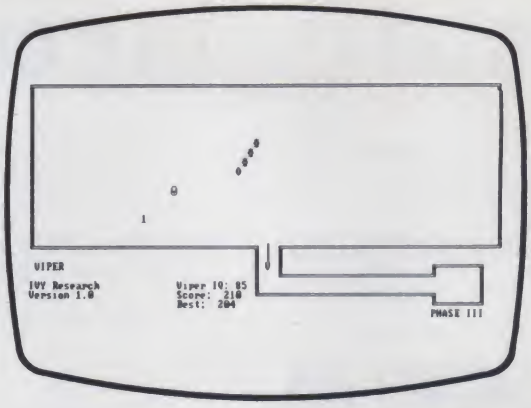
The game is hard and offers challenge. As I have said before, your intuition will work, and you will not be surprised by unexpected monsters. The tradition of the *Zork* games is carried in *Deadline;* a big vocabulary, sentences (including compound ones), and interaction with people in the mystery are strong features.

creative computing
SOFTWARE PROFILE

Name: Deadline
Type: Mystery game
System: 48K IBM/PC, disk drive, either display
Format: Disk
Language: Interlogic machine language
Summary: A new genre, and excellent to boot
Price: $49.95
Manufacturer:
Infocom, Inc.
55 Wheeler St.
Cambridge, MA 02138



Slynx.



Viper.

creative computing
SOFTWARE PROFILE

Name: Slynx and Viper

Type: Arcade-style games

System: 64K IBM/PC, disk drive, any 80-column display

Format: Disk

Language: C

Summary: Excellent

Price: $34.95 (Slynx), $29.95 (Viper)

Manufacturer:
Ivy Research, Incorporated
88 Yale Station
New Haven, CT 06520

I was a little skeptical about these games at first, because I didn't think a good arcade-style game could be written using only the character graphics set. I was wrong. Both these games are challenging and fun. They are also very fast, and you'll have a lot of trouble getting proficient enough to play them at the fastest level.

In both games, the object is to collect points by "eating" them off the screen. In *Slynx,* you are the snake and you get longer as you eat the points. You lose at *Slynx* whenever your head hits the wall or your snake's body. In *Viper,* the snake is the enemy, prowling around and generally making a nuisance of itself. You lose at *Viper* if the snake touches you.

The sound can be suppressed in these games, making them suitable for office play. Joysticks are supported. Ivy is also working on *Dungeoneer,* an "interactive, full-screen sword and sorcery adventure"; *Medusa,* something like the arcade game Qix; and *Cashman,* a maze game.

Temple of Apshai is quite well-known and apparently very popular. It is interesting because it is done with animated graphics and sound. You move a player through a maze of rooms, facing dangers at every turn. You are armed with a sword, with which you can thrust or parry, and a bow, with which you can shoot arrows. Swords swish and arrows fly as you fight spiders, skeletons, and other monsters. All this is very well done, and exciting, especially the first few times you play.

I have two negative feelings about the game. The first is that it does not keep me as interested as, for example, *Zork.* The *Apshai* graphical representation of the rooms is limited to a display of walls and hallways. Although

creative computing
SOFTWARE PROFILE

Name: Temple of Apshai

Type: Adventure game

System: 64K IBM/PC, disk drive, color/graphics display

Format: Disk

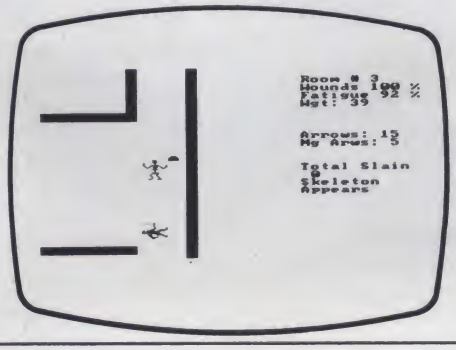
Language: Basic

Summary: Well-implemented, but slow paced

Price: $39.95

Manufacturer:
Automated Simulations
P.O. Box 4247
Mountain View, CA 94040

Temple of Apshai.



Zork has no display, the descriptions evoke the sophisticated picture system called human imagination. I see more with *Zork* than with *Apshai.* The second is the pace of the game, which I found very slow. Especially frustrating was my player's fatigue level, which seemed to rise quite rapidly. Frequent rest stops were necessary to reduce fatigue, slowing the progress of the game even more.

One thing I did not like was the necessity to have the manual on hand at all times to provide me with additional information about the rooms and the treasures. I thought that information should have been available interactively from the program.

One thing I did like was the opening dialog between you, a traveler to the temple, and the Innkeeper, who provisions you for your journey. It is very well done, and extremely entertaining. I found the Innkeeper's negotiating skills very funny.

This game may be particularly appealing to younger players who will be attracted by the graphics. Adults should try it first, and buy only if the features prove interesting.

creative computing
SOFTWARE PROFILE

Name: Millionaire: The Stock Market Game

Type: Game

System: 64K IBM/PC, disk drive, either display

Format: Disk

Language: Basic

Summary: Complex and realistic stock market simulation

Price: $49.95

Manufacturer:
Micro-Z Applications
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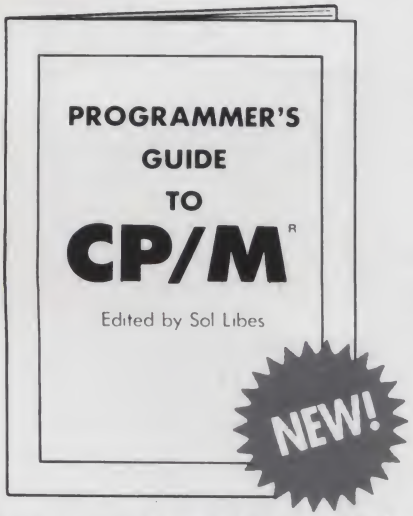

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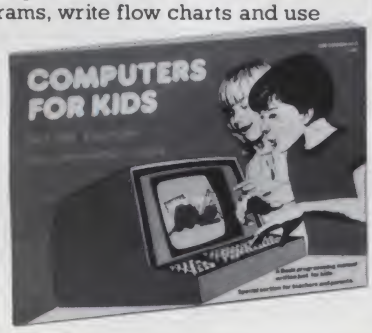

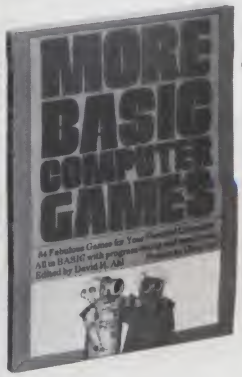

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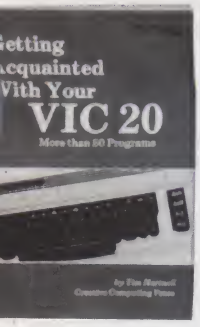

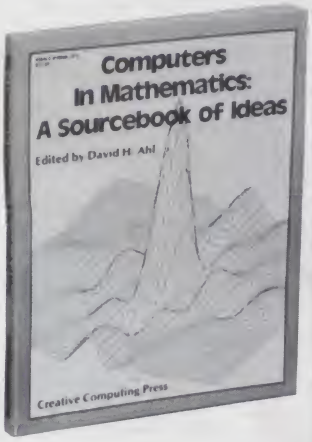

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creative computing

SOFTWARE PROFILE

Name: Stocks & Bonds

Type: Game

System: 64K IBM/PC, disk drive, either display

Format: Disk

Language: Basic

Summary: Simplistic stock market simulation, but entertaining.

Price: $25

Manufacturer:
MicroComputer Games/
Avalon Hill
4517 Harford Rd.
Baltimore, MD 21214

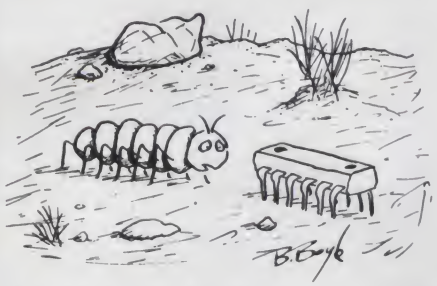
Both of these games are simulations of investment trading in the stock market. The similarity between them ends here.

Millionaire is a very complex game and has obviously been put together with much care. The simulation is detailed, and the player can invest by buying and selling stocks, calling and putting options, and by borrowing against his net worth. However, these investment opportunities must be earned. You begin the game as a "novice," and by improving your net worth advance to "speculator," "professional," "broker," and ultimately "millionaire" (the object of the game). As you attain each new level you gain new abilities.

The game is played by one player at a time. However, the system can save the game status for up to 14 players. The saved games are stored by player initials and are easily retrieved. As you might expect, the games can be quite long. A side-effect of the complexity is that it takes about five minutes to set up a new game.

Stocks & Bonds is a much simpler game. Up to six may play at one time, and the game moves rapidly. The simulation is not complicated at all, but the number of possible combinations of events makes detecting the playing patterns difficult.

I recommend *Stocks & Bonds* for someone looking for entertainment and *Millionaire* for someone who is serious about playing and willing to invest the necessary time.



"I like you a lot. I'm just not ready for the sedentary life."

creative computing

SOFTWARE PROFILE

Name: Lost Colony

Type: Simulation game

System: 48K IBM/PC, disk drive, either display, 80-columns

Format: Disk

Language: Basic

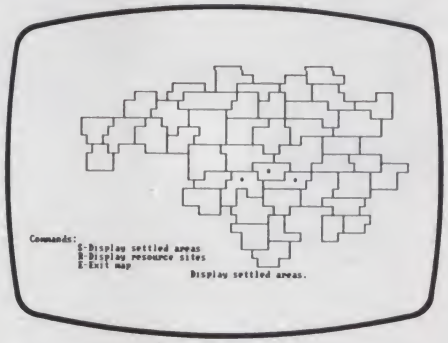
Summary: Complex but interesting simulation

Price: $29.95

Manufacturer:
Acorn Software Products, Inc.
634 North Carolina Ave., S.E.
Washington, D.C. 20003

Lost Colony is a simulation of a population of humans stranded on a planet far from Earth. You have been elected the "economic manager" and given the primary responsibility for the development of the planet. It is up to you to juggle all the resources and try to keep the standard of living, and the population's morale, up.

It is a tough job, though, and a careful balance and even hand are required. And you must balance your time too, because the game can be very long. Games can be saved; the saved game always has the same name so different saved games require different disks.



Lost Colony.

The game is primarily a text game, but a map of the colony can be displayed on either a graphics display or on the standard IBM monochrome display. The screen image shown here was derived from the monochrome.

All in all, the *Lost Colony* is a good simulation that will require thoughtful play to master.

creative computing

SOFTWARE PROFILE

Name: Casino Blackjack

Type: Game

System: 64K IBM/PC, disk drive, color/graphics display

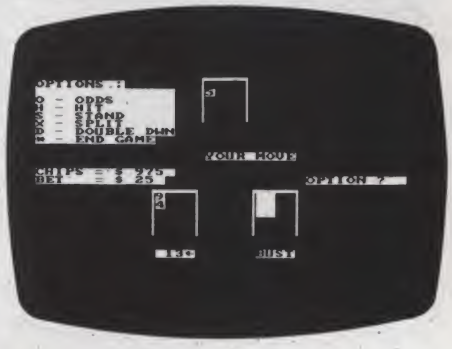
Format: Disk

Language: Basic

Summary: Very good, with minor deficiencies

Price: $24.95

Manufacturer:
Survey Systems, Inc.
7507 Princeton Ave.
College Park, MD 20740



Casino Blackjack.

There are quite a few Blackjack games on the IBM PC market already. I don't understand this, but maybe that's because I'm not a high roller. Both of the game collections reviewed here (see following profiles) include Blackjack, and there are at least four other versions which I have seen advertised but have not tried. My friend Rich even wrote himself a version as one of the very first programs written on his PC.

Casino Blackjack is a pretty good version, and may be the package to buy for someone who wants to learn all the details of the game. The documentation claims that the program simulates casino rules "exactly," something I can't verify. It comes set to play by Atlantic City rules, but all the parameters can be adjusted to whatever casino rules might be more interesting to you.

What's really interesting about this version, however, is its ability to show you the odds of a hit or stand decision, to show you the cards remaining in the deck, and to keep count of the cards to assist you in learning how to become a "counter."

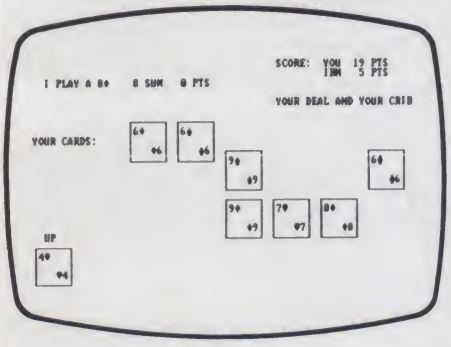
My play of this version was pretty simple, and since I am not interested in learning a technique which will get me thrown out of any casino in the world, I didn't examine the advanced features at any great length. My only criticism

of the game is its requirement for a graphics display, since the versions from the packages below did very nicely on the monochrome display. I found Survey's graphics a little hard to read, especially in black and white.

creative computing
SOFTWARE PROFILE

Name: Games Package I
Type: Game set
System: 48K IBM/PC, disk drive, either display
Format: Disk
Language: Basic
Summary: Good games; extraordinary value
Price: $29.95
Manufacturer:
Ensign Software
2312 N. Cole Rd., Suite E
Boise, ID 83704

This package is a great buy. The games included are Qubic (three-dimensional Tic-Tac-Toe), Othello, Kingdom, Cribbage (!), Black Box, Space Trek, Blackjack, Mastermind, and two facts quizzes, Americans and Presidents.



Cribbage.

I love Cribbage, which is a card game, and I played quite a few of the games. The program plays quite well, as it won a majority of games against a very good player (me!). I found it to be a little slow, but not intolerable. The representation of the play is very well done.

Space Trek is a pretty good version of the Star Trek game. The display is clean and the game is smooth. Blackjack play is represented very nicely, perhaps better than the others I have seen. I didn't like the display of Qubic, since it is hard to see diagonals. Black Box, a game in which you must locate invisible objects in a box by shooting rays in and seeing where they come out, was very nicely done. Othello was a little slow, and since I won with my limited experience, I assume the game could be better. Other players (I *do* try to get other opinions) say they liked it.

These games share one thing in common: they are very well engineered and are mostly idiot proof. A menu is included from which each game can be invoked, and the menu returns at the end of each game. The instructions are clear and the human factors are above average.

creative computing
SOFTWARE PROFILE

Name: FriendlyWare: P.C. Introductory Set
Type: Game Set (and more)
System: 64K IBM/PC, disk drive, either display, 80-columns
Format: Disk
Language: Basic
Summary: A lot of programs, medium quality
Price: $49.95
Manufacturer:
FriendlySoft, Inc.
213 Pebblebrook
Arlington, TX 76014

My reaction to this package is mixed. Of all the games, my favorite was Dominoes, which was surprisingly good with a very satisfactory screen display. The FriendlySoft versions of games which I have tried in other packages, such as Othello or Blackjack, were not as good as their competitors. None of the included games were action games, although there was some limited animation in Sea Battle.

The only other game in the package that I had real fun with was Match, a version of the Concentration television game show. The game was a very faithful recreation of the TV version, and summoned up visions of Hugh Downs and the famous clacking gameboard. In fact, the computer display looks just like the TV board.

The strength of the product lies elsewhere, it turns out, in the program called "Introduction to Computers." This is an on-line tutorial, paralleled by the manual, that describes how the PC works and provides some history of computing. The best part is "Anatomy of a Program" in which FriendlyWare's version of Mastermind is dissected and explained.

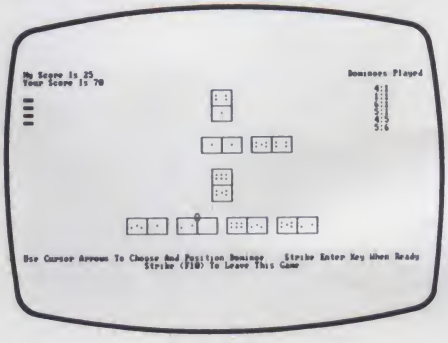
I would have rather settled for fewer programs (there are 25 on three disks) but better versions of those included.

creative computing
SOFTWARE PROFILE

Name: Programs #1: Nine Programs for the IBM Personal Computer
Type: Programs for personal use
System: 48K IBM/PC, disk drive, either display (some games require graphics)
Format: Disk
Language: Basic
Summary: You can probably write them yourself.
Price: $19.95 ($2 shipping)
Manufacturer:
Pittsburg Computer Exchange
112 Marble Dr.
Bridgeville, PA 15017

This package of games loses out by comparison with Ensign's *Games Package I.* The nine programs (IRA calculator, Math Practice, Guess the Number, Target Practice, Sketch Pad, Mortar and Tank, Box Game, Gas MPG Comparison, and Race Cars) are not of professional quality. Only one game, Mortar and Tank, held my interest for any length of time, and I was still frustrated by the way in which the game worked. I suppose my biggest objection to the set is the fact that all the programs could be written in short order by a relatively inexperienced programmer, and I don't like to spend money when that's the case.

The package was out early in the life of the PC, *and perhaps* it was hasty. I have not seen any other products from the same manufacturer.



Dominoes.

Mortar and Tank.

creative computing
SOFTWARE PROFILE

Name: Andromeda Conquest

Type: Game

System: 48K IBM/PC, disk drive, either display

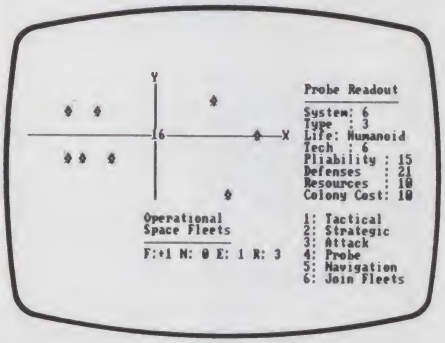
Format: Disk

Language: Basic

Summary: Interesting, but difficult to understand and play

Price: $25

Manufacturer:
Microcomputer Games/
Avalon Hill
4517 Harford Rd.
Baltimore, MD 21214



Andromeda Conquest.

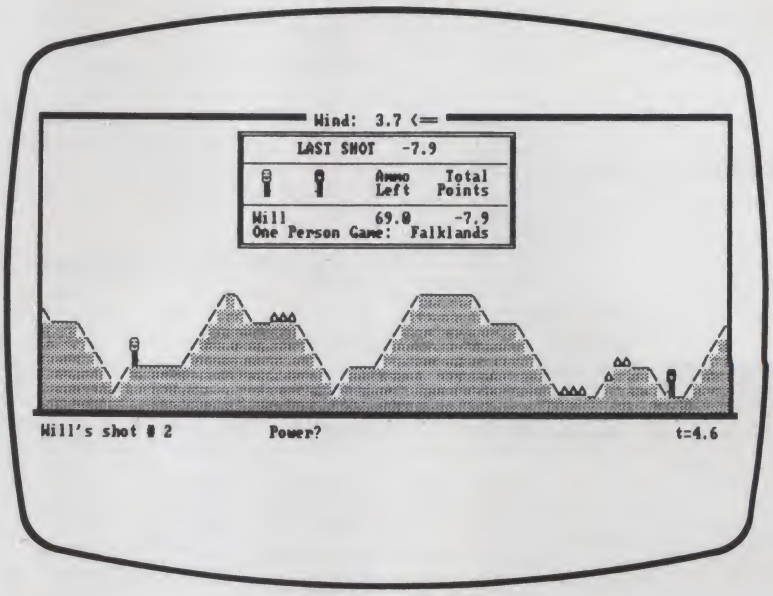
You must take these comments with a grain of salt. I can't believe the game is as difficult to play as I found it, and I think maybe I have a blind spot. I just couldn't get going, couldn't understand the instructions, and couldn't see the point. However, Avalon Hill has built the game for TRS-80, Atari, Apple, and Pet, and I can't believe they would have bothered with the PC version if the game hadn't been popular.

My main problem was figuring out how the game worked. I really got twisted up, and since I couldn't immediately see the effect my moves were having, I wasn't getting the feedback needed to learn the game. I also thought that there was not enough information on the screen, or at least available on-line.

You might want to check with someone you know who has the game and is familiar with it. They can help you decide if the game is worth the investment. The fact that I couldn't get the hang of it is no indictment.

I love *Projectile*. I played against Rich and he likes it too.

The game is simple. A very pretty display, considering it uses only the character graphics set, is drawn showing terrain (which varies from game to game), cities, and combatants. You must specify the power of your shot, and the angle of your cannon. You must consider the wind, which varies in intensity and direction; the terrain, which may include a mountain or valley or two; and the location of cities, which result in penalties if hit. The object is to obliterate your opponent (the game is considerably less violent than these words make it seem).



Projectile.

creative computing
SOFTWARE PROFILE

Name: Projectile

Type: Game

System: 64K IBM/PC, disk drive, either display, 80-columns

Format: Disk

Language: Basic

Summary: Excellent game; very entertaining

Price: $20

Manufacturer:
KK Games
251-D Quinby Rd.
Rochester, NY 14623

The program loading instructions are on the disk label, and the operating instructions are provided by the program. It is very easy to use and very smooth in operation. You can play against an opponent or by yourself.

Although simple, the game is very entertaining. There are many little features that are very well done. The only improvement I could think of was a better way to select the force and angle of shot so that a non-reading child could play. My son likes the looks of the game, but can't play it yet. This is a difficult problem to solve for a game which uses only the character graphics.

I found *Podlaserium* to be addictive in the extreme. I think the concept is good, although once you understand a few principles of the game, you can develop a strategy that will maximize points *provided luck is with you.* That is the essence of the problem, in that the winning strategy doesn't always win.

"...so it only stands to reason that if the same thousand chickens pecked on keypunches for a thousand years that one of them would end up working for IBM."

creative computing
SOFTWARE PROFILE

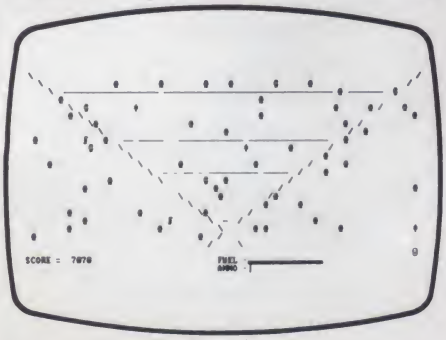
Name: Podlaserium
Type: Game
System: 64K IBM/PC, disk drive, either display, 80-columns
Format: Disk
Language: Basic
Summary: Addictive
Price: $34.95
Manufacturer:
DP Computer Services Co.
5019 North Washington Blvd.
Arlington, VA 22205

"Pods" appear at random in the sky above you. You have one laser cannon at the bottom of the screen, a supply of shots, and fuel to move the cannon from side to side. The cannon will also wrap from right to left and vice versa, a fact not mentioned in the instructions. As the pods appear, you shoot them. Each 1000 points earns you additional fuel and each 2000 points earns you more shots. The game is over when either fuel or ammunition is exhausted.

The pods have different values: 10, 50, 100, or 300 points. Since you have about 40 shots initially, it is obvious that shooting at 10-point targets won't ever earn you an ammunition bonus. So the trick is to get the high scoring targets at all times, leaving the other pods in place. If the game does not offer sufficient high-value targets, you are stuck. In addition, it is critically important to make every shot count. A missed shot reduces significantly your chance of attaining a high score.

Of all the games I tested, I had the most objections to this one even though I played it a lot. I found it slow, and somewhat tedious. There were too many questions to answer between games, making getting to the next game an annoying experience. Upper case input is required. The use of the F7, F9, and F10 keys is preposterous, although left-handed players might like it. The end game processing, in which the game subtracts remaining pods from your score, takes 90 seconds — far too long (I used the BREAK key and restarted the program to avoid this phase, even though it meant losing the ability to store high scores).

The game requires a password to operate. The purchaser must call the company to obtain the password for his version. I understand the motive, but consumer products can't really work that way.



Podlaserium.

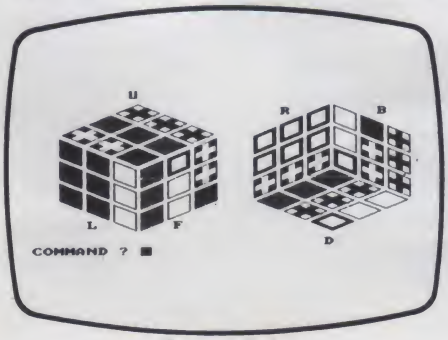
creative computing
SOFTWARE PROFILE

Name: CompuCube
Type: Game
System: 48K IBM/PC, disk drive, color/graphics display
Format: Disk
Language: Basic
Summary: Very good Rubik's Cube program that can solve a scrambled cube
Price: $29.95
Manufacturer:
Stoneware, Incorporated
50 Belvedere St.
San Rafael, CA 94901

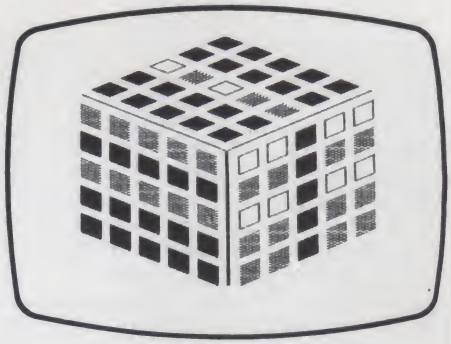
creative computing
SOFTWARE PROFILE

Name: Polycube
Type: Game
System: 48K IBM/PC, disk drive, color/graphics display
Format: Disk
Language: Basic
Summary: Fast cube program with seven cube sizes
Price: $26.95
Manufacturer:
Linear Aesthetic Systems
P.O. Box 23
West Cornwall, CT 06796

These two programs enable you to manipulate Rubik's Cube. *CompuCube* is the more sophisticated of the two because it also will solve a scrambled cube that you set up. It cannot be fooled — an impossible cube configuration will be identified as such. The program allows either 2x2 or 3x3 cubes to be manipulated.



CompuCube.


Polycube.

The biggest problem with the program is that each move is displayed rather slowly. The entire screen is cleared and the cube is redrawn. *CompuCube* also displays the backside of the cube, a nice feature that sometimes can also induce some confusion.

Polycube allows cubes from 1x1 to 7x7. The display is very fast as only the faces that change after a move are redisplayed. The back of the cube is not visible.

Polycube is for those wishing to have a computerized version of the cube, and more sizes than the physical game device allows. *CompuCube* is for those wishing to have the computer solve the puzzle from any starting point. This is the strongest feature of *CompuCube:* it can show you, step by step, how to solve a cube you set up.

creative computing
SOFTWARE PROFILE

Name: Galaxy Master
Type: Arcade game
System: 64K IBM/PC, disk drive, either display, 80-columns
Format: Disk
Language: Basic
Summary: Reasonable concept, but too slow
Price: $29.95
Manufacturer:
Info-Pros, Inc.
2102 Business Center Dr.
Suite 132
Irvine, CA 92715

In *Galaxy Master* you control a ship which can move anywhere on the screen with its laser pointing toward the top at all times. Enemy ships move across the screen from right to left and will file on you if they get too close. The object is to score as many points as possible without getting destroyed.

I would have enjoyed the game more if it ran faster. I think this is one game that could benefit from the Basic Compiler. The main problem is that keystrokes don't necessarily take effect the instant you make them. They are stored by the PC keyboard buffer, and Basic sees them when it gets around to it. This creates the situation in which you are directly under the enemy ship and you hit the fire key, only to discover that the program is not listening to you. Result: you are zapped, but left wondering how it could have been avoided. The answer is to fire *before* the target is actually in front of you. Torpedoes also suffer from the slowness of the game — it is tough to learn when they should be fired.

Unless the game becomes more responsive in a future version, it is hard to recommend.

creative computing
SOFTWARE PROFILE

Name: Football Predictor

Type: Serious game

System: 64K IBM/PC, disk drive, either display

Format: Disk

Language: Basic

Summary: For those interested in predicting game outcomes

Price: $39.95

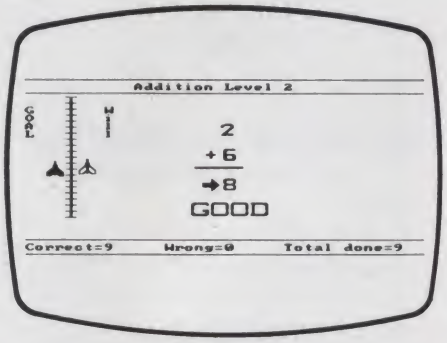
Manufacturer:
C&C Software
316 Nancy Lynn Cr., Suite 26-B
Knoxville, TN 37919

I haven't had time to really try this program, and I list it here only because by the time you read this it will be well into the football season. The program runs smoothly, asking clear questions about the information it wants. It provides a simple answer: which of two teams will win, and by what score.

The only problem I have with this game is that it cannot save data, so you must manually record all the data and re-enter it each time. The program admits to real value only after four or so weeks worth of information has been collected. Once the data is entered, the program compiles the statistical result.

Educational Products

IBM has been the most aggressive so far in the announcement of products for the education market. Of the six packages I have, four came from IBM and a fifth from IBM subsidiary, SRA (Science Research Associates). Actually, three of the four IBM offerings were also written by SRA. Here they are.



Fact Track.

"Now that's my idea of a 'user-friendly' system!"

I can say with some authority that this is an excellent product. I tried it myself for a while, but the acid test came when I took my computer to my son's school for a demonstration. The class was pre-first, in between kindergarten and first grade. The children have some reading skills, and all know their numbers. They have some ability to add and subtract small numbers, so *Fact Track* was not beyond their abilities.

creative computing
SOFTWARE PROFILE

Name: Fact Track

Type: Educational game

System: 64K IBM/PC, disk drive, color/graphics display

Format: Disk

Language: Basic

Summary: Excellent arithmetic facts teaching game

Price: $90

Manufacturer:
IBM/SRA
P.O. Box 1328
Boca Raton, FL 33432

What amazed me was the readiness with which the kids played at the drill. They really liked it, and those who played again improved. The program is very well-written and extraordinarily well-engineered. I think the part that shows each kid the score for the round by running a flag proportionally up the flagpole both amused them and gave them a competitive objective.

I did not have the time to try all the game options on that class, but my son has tried several of them, and he is willing to play for quite reasonable amounts of time, considering that there are no space ships or monsters.

Both of these game sets include two

creative computing
SOFTWARE PROFILE

Name: Arithmetic Games (Set 1 and Set 2)

Type: Educational game

System: 64K IBM/PC, disk drive, color/graphics display

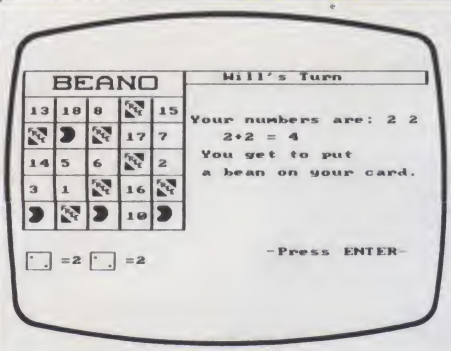
Format: Disk

Language: Basic

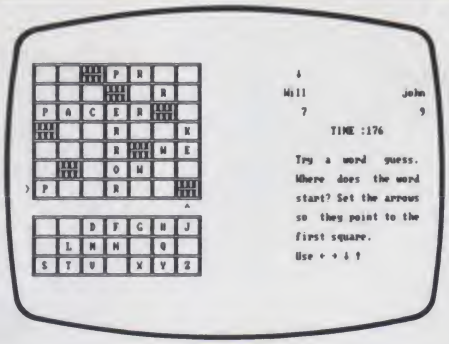
Summary: Excellent arithmetic facts teaching game

Price: $60 each

Manufacturer:
IBM/SRA
P.O. Box 1328
Boca Raton, FL 33432



Arithmetic Games.



Cross Clues.

games. I liked Set 1, with Beano and Rockets, best.

Both sets have the same objective. They try to teach arithmetic relationships in an entertaining fashion. I'll use Beano as an example.

Beano is a Bingo-like game. The computer issues you a card with a 5x5 grid and numbers in each square of the grid. Some of the squares are marked FREE and have no number; the level of the game being played determines how many free spaces are given. The computer then rolls the dice for the player. The numbers from the dice must be used to write a formula that will yield one of the numbers showing on the card. If such a formula can be built, a "bean" is placed on that square. The object is to get a row of beans in any direction.

The formulas can include addition, subtraction, multiplication, and division, and parentheses can be used to force a desired order of evaluation. Simply stated, these games teach "How can I put these numbers together to get a result that will help me win?"

A single player can play against the computer or two players can compete. There are different levels of play; I found that the hardest level for me against the easiest level for Josh (age 6) was fair — he won.

As with *Fact Track* these games are well-written and well-engineered.

creative computing
SOFTWARE PROFILE

Name: Cross Clues (Set 1)
Type: Word game
System: 64K IBM/PC, disk drive, either display
Format: Disk
Language: Basic
Summary: Original word game requiring fast thinking
Price: $29.95
Manufacturer:
Science Research Assoc., Inc.
155 North Wacker Dr.
Chicago, IL 60606

SRA is marketing this one on their own, unlike the products they did for their parent which then carried the IBM logo. *Cross Clues* is also available for the Apple, which may account for the difference in marketing strategy.

I think the game is interesting, but it received mixed reactions from my wife and our guests one evening. The game can be very tough, and you play against the clock (as well as an opponent). The object is to find as many of the words as possible and achieve the highest possible score while doing so.

The game displays a grid much like a crossword puzzle. You must randomly guess letters to get started, as there are no crossword puzzle clues. As you get letters, and then words, those letters showing on the board begin to provide clues about subsequent words. As you succeed or fail, you also provide information to your opponent, so some strategizing is necessary.

Fifty different sets of words are provided, and any game can be called up randomly. A chart is provided in the instructions so you can keep track of which sets you have played.

creative computing
SOFTWARE PROFILE

Name: Typing Tutor
Type: Educational product
System: 48K IBM/PC, disk drive, either display
Format: Disk
Language: Basic
Summary: Microsoft's famous program for the IBM
Price: $25
Manufacturer:
IBM/Microsoft
P.O. Box 1328
Boca Raton, FL 33432

I can keep this one short. *Typing Tutor* has been reviewed many times, and always favorably. All I'll say about the IBM version and my use of it is that I am very impressed.

creative computing
SOFTWARE PROFILE

Name: The Speed Reader
Type: Educational product
System: 64K IBM/PC, disk drive, either display
Format: Disk
Language: Basic
Summary: Learn to speed read by computer
Price: $74.95
Manufacturer:
Davidson and Associates
6069 Goveoak Pl., #14
Rancho Palos Verdes, CA 90274

The Speed Reader is a product that allows you to learn to speed read with your IBM PC. It includes all the features I remember from my speed reading course, and provides excellent eye movement exercises (eye movement is critical for speed reading). The product is a combination of the software programs on the disk and the program of study in the manual. Following the program carefully, in the order prescribed by the manual, should result in the improvement of your reading speed with no loss of comprehension.

I think the program is well-engineered and will be a very satisfactory investment for someone wanting to improve his reading skills. It is less expensive than a course and has the advantage of allowing you to work at your pace with an instructor who will not tire.

The program is also available for Apple Computers.

That's it. Next month, more games, home financial programs, and more. 'Til then, Merry Christmas (or is it Happy Thanksgiving?). □

"This machine is guaranteed for ten thousand operations or until it malfunctions, whichever comes first."

Greg Yob

Personal Electronic Transactions

I am happy to hear from you, and encourage your correspondence. I will try to acknowledge all correspondence, and a SASE makes things easier for both of us. Please send your letters to "Personal Electronic Transactions" c/o PO Box 354, Palo Alto, CA 94301.

Well, this is the Christmas issue of our favorite magazine, so I thought I would help the VICfolk in finding appropriate holiday gifts. I did NOT realize what I was getting into—I found over 55 manufacturers and eventually looked at over 200 products. That's right, this column has 200 products listed and evaluated for your purchasing pleasure. Doing this took nearly a man-month of my time, so this folly will not be repeated.

First, some comments concerning the evaluations. A fair and complete evaluation of each product was impossible to do. Instead, I took a brief look at each product and used it for a few minutes. In most cases this was enough to assign a Stars rating to the item—my six years in the PET world has acquainted me with most of the varieties of software, so getting the 'feel' of a product by taking a brief look is more accurate than you might think.

The Stars ratings work about like this:

6 Stars: This is an incredibly well done and superb product. If you have any interest at all, get it.

5 Stars: This is a well done product. You will enjoy its use and the style is good also, so understanding it is not a problem.

4 Stars: A solid product though it could be improved.

3 Stars: This will do the job and is quite adequate. In some cases the product is good, but not very interesting.

2 Stars: This product works ok, but there's no reason to get it unless it fits your needs.

1 Star: Either the idea is poor, the execution shows a total lack of style or knowledge of the VIC, or the product has serious bugs or shortcomings. Use only if you are desperate.

No stars: Hopelessly bad or has catastophic bugs.

Now, I am not an objective reviewer. In fact, my 'hidden agenda' is probably longer than yours. I can describe a few prejudices, so here goes: First, the VIC is a small machine, and many applications, particularly business and education are very, very hard to do on an unexpanded VIC. That's why the cartridges and programs requiring memory expansion tend to do better. In fact, education is the *hardest* area to do good software for, and business is the *second hardest* area. Games lie in the middle and physical hardware is also medium in difficulty.

Third, I look for style, creativity and usefulness. A product that is adequate tends not to be seen, and you will find these at two and three stars. If a product does not really use the VIC's facilities, I get bored. Fourth, I am intolerant of poor or boring programs being fobbed off as educational or business applications and will not accept the excuse that," well, It's for children."

Lack of space prevents me from giving any mini-reviews of the top 20 products—doing so would double the length of this column. However, here are a few notes to consider while browsing through the lists:

1. If two products in the same category have the same number of stars, the product listed first is somewhat better. For example I consider *Chomper* better than *Trashman* in Figure 1.

2. 8K RAM refers to having the 3K or 8K expansion cartridge mounted in the VIC. Some programs will require one or the other specifically. If it is a business program, the 8K or 16K or 24K will suffice.

3. Get a joystick.

4. Read the Manufacturer's Code carefully. The Manufacturer's List is arranged in the order of the Codes which is not quite alphabetic.

5. *Astroblitz* is far and away the best cartridge game. It requires a joystick.

6. Vic Forth is the FORTH language, which is for those involved in programming work. FORTH is fascinating, but not for the casual user.

7. *Chomper, Snakman* and *Trashman* are variations on *Pac-Man*.

8. The *VIE* and *Promqueen* are for really serious VIC users.

9. If you buy something based on these lists, let me know how it all came out for you.

Figure 1. The Top 20 VIC Products.

Rank	Stars	Product Name	Price	Manufacturer	Type
1	******	Astroblitz	$ 46.95	CSW	Game Cartridge
2	******	VIC Forth	$ 59.95	HES	FORTH in Cartridge
3	*****	Alphacom Printer	$219.00	ALP	40 col Printer
4	*****	Defender on Tri	$ 12.95	NUF	Game Tape
5	*****	Chomper	$ 12.95	RAC	Game Tape
6	*****	Trashman	$ 46.95	CSW	Game Cartridge
7	*****	Hopper	$ 12.00	DES	Game Tape
8	*****	Snakman	$ 24.95	MDG	Game Tape
9	*****	VIE (IEEE-488)	$ 79.95	MCS	Interface Cartridge
10	*****	PromQueen	$174.50	GCB	Development Cartridge
11	*****	Terminal 40	$ 29.95	MMA	Terminal Tape
12	*****	Public Domain Vic	$ 10.00	PUD	80 Progs on Tape
13	*****	HesWriter	$ 39.85	HES	Wordproc Cartridge
14	*****	BUTI	$ 34.95	UMI	Utility Cartridge
15	*****	VIC Carrying Case	$ 89.95	CAY	VIC Suitcase
16	****	Softpedal	$145.00	PAC	Exercycle system
17	****	Printor	$ 49.95	UMI	RS 232 Interface
18	****	Expandor	$ 59.95	PTI	3 Slot Motherboard
19	****	Turtle Graphics	$ 39.95	HES	Turtle Cartridge
20	****	Typing Tutor	$ 9.95	ACS	Educational Tape

Figure 2A. Cartridges.

VIC Cartridges - Games and Entertainment

Rating	Product Name / Description of Product	Needs	Price	Mfr. Code
******	Astroblitz An excellent arcade game similar to 'Defender'	Joystick required	$ 46.95	CSW
*****	Trashman Variation of PacMan using garbage trucks & big California flies	Joystick optional	$ 46.95	CSW
****	Aggressor Similar to 'Defender' arcade game	Joystick optional	$ 39.95	HES
****	Sargon II Plays chess on the VIC - reasonably well	Joystick optional	$ 39.95	CSJ
****	Black Hole Shoot down debris near a Black Hole without falling in	Joystick optional	$ 46.95	CSW
****	Satellites & Meteorites Like asteroids with more interesting goodies to shoot at	Joystick optional	$ 49.95	UMI
****	Renaissance Plays a hard game of Othello, choice of level of play	Joystick optional	$ 49.95	UMI
****	Cloudburst Destroy nasty stuff falling from clouds before they zap you	Joystick optional	$ 39.95	UMI
****	Radar Rat Race Move a mouse thru a maze, eat cheese, avoid cats and rats	Joystick optional	$ 29.95	CBM
***	Super Alien Go about a maze and trap aliens	Joystick optional	$ 29.95	CSJ
***	VIC Avenger Space Invaders in color for the VIC	Joystick optional	$ 29.95	CBM
***	Jupiter Lander Like Lunar Lander with some extensions	Joystick optional	$ 29.95	CSJ
**	Road Race Like the 'Night Driver' arcade game but not as good		$ 29.95	CBM
**	Poker Plays 5 card draw poker with limited betting options		$ 29.95	CBM
*	SuperSlot Simulates a Slot Machine - All you do is pull the handle	Joystick optional	$ 29.95	CBM

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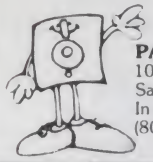

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PET/VIC, continued...

VIC Cartridges - Programming Tools

Rating	Product Name / Description of Product	Needs	Price	Mfr. Code
♯♯♯♯♯♯	VIC FORTH A complete FORTH with VIC extensions		$ 59.95	HES
♯♯♯♯♯	BUTI This is a 'Programmer's Toolkit' with some nice extensions Note: This is a ROM chip only - you have to mount it in a socket at $A000. UMI's socket cartridge goes for $ 29.95	See Note	$ 34.95	UMI
♯♯♯♯	HESMON Monitor & debugging tools for machine language - like 'extramon'		$ 39.95	HES
♯♯♯♯	Super Expander Adds 3K RAM plus sound & graphics commands to BASIC		$ 69.95	CSJ
♯♯♯♯	Programmer's Aid 'Programmer's Toolkit' for the VIC		$ 59.95	CSJ
♯♯♯	Machine Language Monitor ML Monitor - a bit overpriced - see HESMON which does more		$ 59.95	CSJ

VIC Cartridges-Miscellaneous

Rating	Product Name / Description of Product	Needs	Price	Mfr. Code
♯♯♯♯♯	HESWRITER A surprisingly complete word processing cartridge	printer	$ 39.95	HES
♯♯♯♯	Turtle Graphics Gives a 'turtle languge' for VIC. Not the LOGO standard turtle		$ 39.95	HES
♯♯♯	Mole Attack An educational game for children - helps hand-eye coordination	Joystick optional	$ 29.95	CSJ

Figure 2B. Hardware.

VIC Hardware - Peripheral Devices

Rating	Product Name / Description of Product	Needs	Price	Mfr. Code
♯♯♯♯♯	AlphaCom VIC Printer Low cost fast 40 column thermal printer with full VIC graphics		$219.00	ALP
♯♯♯	Commodore Datasette Tape cassette drive for VIC		$ 75.00	CSJ
♯♯♯	Commodore Joystick Your standard joystick		$ 9.95	CBM
♯♯♯	Commodore Paddles Two game paddles for joystick port		$ 19.95	CSJ
♯♯♯	VicModem Modem plugs into User Port and Modular phone handset (Uses VICTerm 1 software which comes with modem)		$109.95	CSJ
♯♯♯	VIC 1540 Single Disk Drive Disk drive uses CBM 4040 format		$599.00	CBM
♯♯	Vic Light Pen Light Pen & demo programs - I find light pens a bit flakey to use		$ 39.95	SKY

VIC Hardware - Bus Expansion Boards

Rating	Product Name / Description of Product	Needs	Price	Mfr. Code
♯♯♯♯	CardBoard 6 slot expansion with select switches for 2 blocks Note: NO protection of traces from paperclips, etc		$139.95	CAR
♯♯♯♯	Expandor 3 slot expansion board with switches for each slot		$ 59.95	PTI
♯♯♯	Mini Mother A no-frills 3 slot expansion board		$ 69.95	QDI

Rating	Product Name / Description of Product	Needs	Price	Mfr. Code
‡‡‡	3 Slot Mini-Mother A no-frills 3 slot expansion board with plastic cover		$ 69.95	DES
‡‡‡	The Programmer A no-frills 3 slot expansion coated with black paint insulation		$ 69.00	PAR
‡‡	Expansion Mother Board 3 slot expansion - hard to insert but certainly inexpensive & has solder mask over traces		$ 39.95	SLA

VIC Hardware -Memory Expansion Cartridges

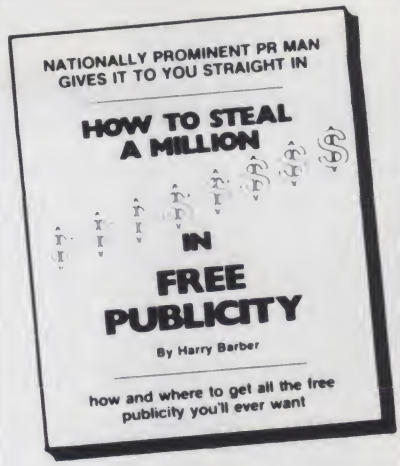
Rating	Product Name / Description of Product	Needs	Price	Mfr. Code
‡‡‡‡	24K RAM 24K ram cartridge		$145.00	MCS
‡‡‡‡	24K Memory Expansion 24K ram - has low power consumption		$169.95	SLA
‡‡‡‡	VIM-16 by Microtek 16K memory expansion with address switches & ROM/EPROM insertability		$129.95	SKY
‡‡‡	VIC 16K Memory Expander Cartridge 16K ram cartridge - hard to get inside to address switches		$109.95	SKY
‡‡‡	VIC 3K Memory Expander Many, many games tapes dislike this cartridge		$ 39.95	SKY

VIC Hardware - RS-232 Interfaces

Rating	Product Name / Description of Product	Needs	Price	Mfr. Code
‡‡‡‡	Printor True RS 232 levels, good instructions		$ 49.95	QDI
‡‡‡‡	RS232C Terminal Interface True RS 232 levels in this interface by Commodore		$ 49.95	CSJ
‡‡	V232 True RS232 levels, but no protection from shorts and mounting of some components may lead to breakage		$ 45.00	MCS
‡	MDM-1 Two plugs for modem & printer. TTL levels only. Internal construction is very shoddy & hard to repair		$ 62.00	RVR
‡	MDM-2 One plug for modem. TTL levels only. This is a kit - if you buy the assembled version it is put together with some IC pins not soldered.		$ 31.00	RVR

VIC Hardware - Unique Items

Rating	Product Name / Description of Product	Needs	Price	Mfr. Code
‡‡‡‡‡	VIE Cartridge which provides a true IEEE-488 interface. This lets the VIC connect to any standard PET/CBM peripheral. Very handy for VIC product development people		$ 79.95	MCS
‡‡‡‡‡	Promqueen Eprom burner with 4K ram & eprom with burn code & hex editor Note: 4K ram allows access by external cpu for emulation & development work		$174.50	GCB
‡‡‡‡	40/80 Video Combo Package 16K ram plus 40 & 80 column video converter Note: Video is black & white. In 80 col mode you need a monitor Display is 24 lines high, not 25 as in PET/CBM		$299.95	QDI
‡‡‡‡	HESCOM A cable to connect VIC User Port to PET/CBM User Port and software to handshake data between the two. Useful for developing VIC programs when your best tools are on your PET.	Standard PET/CBM	$ 49.95	HES
‡‡‡‡	A/D/A - Converter 8 channel 8 bit A/D, 1 channel 8 bit D/A on 0-5v range Software driven SAR/comparator for A/D		$129.95	MWE



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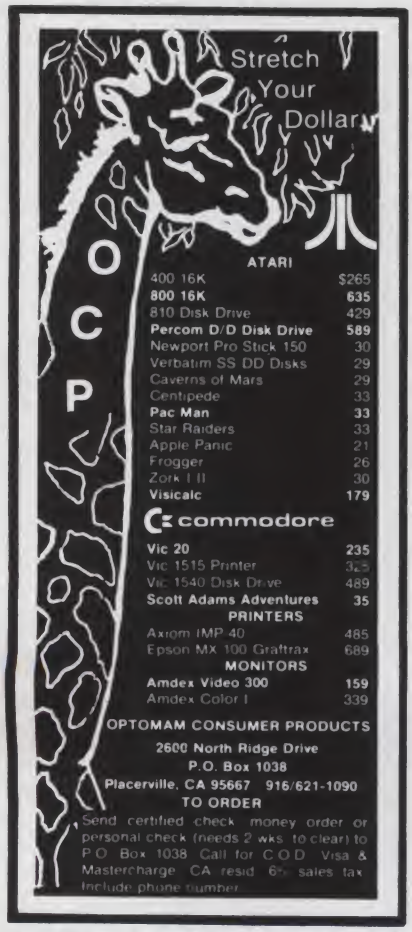

CIRCLE 260 ON READER SERVICE CARD

PET/VIC, continued...

Rating	Product Name / Description of Product	Price	Mfr. Code
!!	Prototype / Experimenter's card for VIC Kludge card for EE types to fit in VIC. Note: There is a standard Vector prototyping card for about $13.00 which works quite well if you have wire-wrap tools or Flea Clips. Available at most electronic parts stores	$ 18.95	ELC

VIC Books & Magazines

Rating	Product Name / Description of Product	What	Price	Mfr. Code
!!!!	VIC Revealed by Nick Hampshire Inner details of VIC for machine language hackers & advanced programmers	book	$ 14.95	SKY
!!!!	VIC Computing Monthly magazine from England on VIC $30/yr	magazine	$ 30.00	VCC
!!!!	The TORPET Toronto PET User's Group - has lots on VIC $20/yr	magazine	$ 20.00	TOR
!!!!	COMPUTE! General PET/ATARI/APPLE magazine with VIC articles $20/yr	magazine	$ 20.00	CPU
!!!	Power / Play Commodore's VIC users magazine $10/yr	magazine	$ 10.00	CBM
!!!	Understanding Your VIC, Volume I Beginning & intermediate VIC BASIC programming	book	$ 11.95	TIS
!!!	VIC 20 Programmer's Ref Guide Commodore's advanced book on VIC	book	$ 16.95	CSJ
!!!	VIC-20 Interfacing Book of electronics projects for VIC. Assumes some electronics experience	booklet	$ 14.95	MSG
!	Personal Computing on VIC 20 You got this one when you bought the VIC	book	$ 5.95	CBM

VIC Unique Items - Not Easily Classified

Rating	Product Name / Description of Product	What	Price	Mfr. Code
!!!!!	VIC Carrying Case A nice suitcase sized case for VIC, power supply, rf mod, tape unit & space for manuals and paperwork. (Note: A larger case to include disk & printer is also available.)		$ 89.95	CAY
!!!!	SoftPedal A stand with fan converts your bike to an exercise bike. Sensor and software uses VIC for pacing, mileage, etc. Software could be improved to make this a 5 star product.	VIC exercycle	$ 145.00	PAC

Figure 2C. Useful Software.

NOTE: All Software comes on cassette tape unless indicated otherwise.
Some vendors offer both tape & disk versions.

VIC Software - Educational

Rating	Product Name / Description of Product	Needs	Price	Mfr. Code
!!!!	Typing Tutor Touch typing drill for the VIC - from easy keys to whole keyboard in many gradual steps		$ 9.95	ACS
!!!	Touch Typing Tutor Teaches touch typing but word generation is random and not like actual text		$ 15.95	TAY
!!!	Stakeout The 'capture boxes' pen & pencil game	8K ram, Joystick req	$ 14.95	TAY
!!!	Frog The PET bug eating frog - for young children		$ 17.95	MCP

Rating	Product Name / Description of Product	Needs	Price	Mfr. Code
‡‡‡	Banner / Headliner Printer banners & headlines - no provision for non 80 col printer	80 col printer	$ 14.95	MMA
‡‡‡	Street Maze Navigate a city via taxicab - relates street grid to giving directions		$ 7.95	CDS
‡‡‡	Vixel # 1 Two games & a draw on screen program in Hi Res mode	Joystick optional	$ 12.95	CWK
‡‡‡	Vixel # 2 Two more games & a custom character editor which could be used as a programming tool	Joystick optional	$ 12.95	CWK
‡‡‡	Scramble 1 & 2 Unscramble words. Scramble 2 for 2 players		$ 19.95	COB
‡‡‡	Flashcard Maker & Quiz Make flashcards and quiz with them on the VIC		$ 9.95	ACS
‡‡	Lox 'Bagels' for the VIC		$ 6.95	COB
‡‡	1,2,3 / Spelling Bee Hangman and Bagels games		$ 19.95	COB
‡‡	Flash 'N Spell Flashcards oriented towards spelling drill		$ 15.95	QMX
‡‡	Word Invaders Typing practice - goes with Typing Tutor by ACS		$ 8.95	ACS
‡‡	English Invaders Shoot invading words by identifying noun, verb or adjective		$ 7.95	CDS
‡‡	Hang-U Hangman using rather hard words		$ 12.00	DES
‡‡	Educational / Recreational Pack I Three rather simple games & drills		$ 14.95	CSW
‡	Gotcha Math Something will eat you if you don't do your math in time		$ 9.95	CDS
‡	Hangman The familiar guess the word game		$ 8.95	ACS
zero	VIC Lemonade Our dull little lemonade stand is now on the Vic		$ 14.95	TAY

VIC Software - Business and Home

Rating	Product Name / Description of Product	Needs	Price	Mfr. Code
‡‡‡‡‡	Terminal 40 Simply the best & nicest VIC as terminal program I have seen 〈〈〈 Definitely a nice program 〉〉〉	8K ram, RS 232	$ 29.95	MMA
‡‡‡‡	Tickertape Smooth scrolling horizontal display of messages		$ 14.95	MMA
‡‡‡‡	Data Manager A simple & usable data base Disk version avail	8K ram	$ 19.95	MSP
‡‡‡	Universal Mailing List Mailing list or simple data base Disk version avail	printer	$ 39.95	COB
‡‡‡	Vitera A Your basic terminal processing program - limited to 300 baud	RS 232	$ 19.95	UMI
‡‡‡	Data Handler (word processor) A badly named word processor - when entering answers to questions there are no defaults - which can catch you!	8K ram, printer	$ 17.95	MWS
‡‡‡	Word Processor Small word processor	8K ram	$ 30.00	ISW
‡‡‡	CopyCalc Perhaps the world's smallest 'VisiCalc'	8K ram	$ 14.95	ISW
‡‡‡	Loan Analyser Two programs which analyse simple loans Disk version avail		$ 14.95	CSW
‡‡‡	Household Finance Four programs for home budgeting Disk version avail		$ 34.95	CSW
‡‡‡	Home Inventory Two programs to inventory & valuate your material things		$ 19.95	CSW
‡‡‡	Car Costs Two programs to journal automotive things		$ 19.95	CSW

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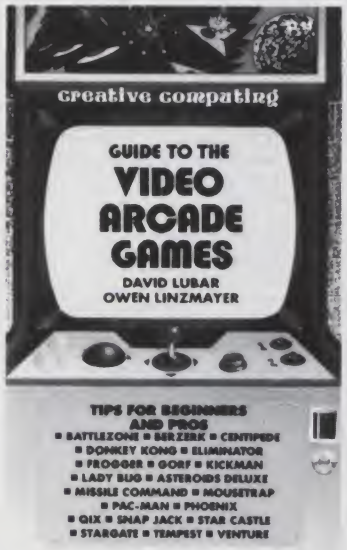

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PET/VIC, continued...

Rating	Product Name / Description of Product	Needs	Price	Mfr. Code
‡‡	Checkbook Keeps checks register, comes in nice plastic binder w/ data tape too		$ 12.95	MIS
‡‡	Home Calculation Program Pack Commodore's home finance, loans, expenses, etc		$ 59.95	CSJ
‡‡	V-Data Base / V-Mail Very limited data base programs - comes with disk version too		$ 29.95	MWE
‡‡	Word Vic A very small word processor	8K ram	$ 19.95	ELC
‡‡	Un-Word Processor A minimal limited word processor		$ 14.95	MMA
‡	Terminal 22 This would rate 3 stars but I couldn't xmit control characters	RS 232	$ 14.95	MMA
‡	Budget II Like CSW's Home Finance - but printer's output gave me nonsense	8K ram	$ 9.95	RAK
‡	Name & Address Enter & recover mailing information		$ 5.95	RAK
zero	Portfolio Manager Enter & recall securities info - this pgm has some bad bugs	8K ram	$ 19.95	MSP
zero	Club Lister I could have written this program in the time it took to LOAD it		$ 13.95	TSA
zero	Dear Diary ditto, maybe less time		$ 12.95	TSA
zero	Mortgage Comparer CSW's Loan Analyser & a pencil gives you more		$ 8.95	TSA
zero	Savings Account		$ 13.95	TSA
zero	Home Budget ‡‡‡ At this point I quit looking at TSA's demo tape for it was all the same kind of junk. Avoid this vendor!		$ 12.95	TSA
zero	Mailing List Program Probably a nice program but I couldn't follow the directions and it didn't work the way it said it would. I couldn't enter a name for all of my efforts	8K ram, Disk req	$ 24.95	SPE

VIC Software - Programming Tools

Rating	Product Name / Description of Product	Needs	Price	Mfr. Code
‡‡‡‡	Graphics Designer Editor for design of custom character sets		$ 14.95	MMA
‡‡‡‡	Assembler Editor, Assembler, Loader - does syntax check on entry & source code is compacted to allow longer programs then HES. However, the MOS addressing conventions are NOT followed and it does not like spaces after the opcode when entering source code		$ 24.95	FSS
‡‡‡‡	HIRES / Multicolor Two programs to use VIC's high resolution and multicolor modes These are 'wedges' so you can write BASIC programs with the plotting commands included		$ 25.00	ABA
‡‡‡‡	Graph VICS HIRES & Multicolor combined for VICs with more memory. Permits full VIC screen in HiRes mode	8K ram	$ 25.00	ABA
‡‡‡	HES Assembler & Editor Text editor makes source files for Assembler & loader		$ 23.95	HES
‡‡‡	Minimon 6747 Machine Language Monitor		$ 15.95	QMX
‡‡‡	Vic Dis Disassembler of machine language		$ 9.95	ACS
‡‡‡	Disassembler Disassembles ROMs, space limits awkward for other code		$ 14.95	MMA
‡‡‡	Graphics Menagerie Several graphics demos & explanations		$ 11.95	MMA
‡‡‡	VIGIL A mini-language for games. The demos all used quarter square graphics and seemed taken from the RCA VIP. Code written in VIGIL is very hard to read. Not much faster than BASIC	8K ram	$ 35.00	ABA

Rating	Product Name / Description of Product	Needs	Price	Mfr. Code
‡‡	HES Plot Plot in Hi Res mode. Instructions hard to follow		$ 15.95	HES
‡‡	HES Count Generates various statistics on your BASIC programs	8K ram	$ 23.95	HES

VIC Software - Unique Items

Rating	Product Name / Description Of Product	Needs	Price	Mfr. Code
‡‡‡‡‡	Public Domain VIC Collection #1 Some 80 programs on tape or disk. These are public domain programs collected from various user's groups with widely varying quality. ››› This is a bargain you can't ignore! ‹‹‹‹		$ 10.00	PUD
‡‡‡	PIPER Compose & play music on the VIC Disk version avail Note: This program fits Educational and Programming categories too		$ 25.00	ABA
‡‡	Ham Antennas Computes dimensions for ground plane, dipole and yagi antennas given frequency. RAK has many other small programs for the radio ham.		$ 5.95	RAK
‡‡	Morse Code Trainer Practice on recognition of Morse Code Note: Nobody has made a 'Send Morse Code' training program which can be easily done for 5 - 20 wpm		$ 19.95	TAY
‡‡	CW Trainer / Speedometer Recognize Morse code - letters and messages		$ 15.95	RAC
‡‡	Aerobics Points Calculator If you exercise this counts 'aerobics points' which appeals to the number-minded exerciser. I am not sure of all this but you can try it out. Disk version avail		$ 24.95	TAY

Figure 2D. Game Tapes.

NOTE: All Software comes on cassette tape unless indicated otherwise.
Some vendors offer both tape & disk versions.

VIC Software - Games and Entertainment

Rating	Product Name / Description of Product	Needs	Price	Mfr. Code
‡‡‡‡‡	Defender on Tri Fly rescue ship thru several lethal mazes	3 or 8K memory, Joystick opt	$ 12.95	NUF
‡‡‡‡‡	Hopper Hop a Froggie across roads, meadows & other things	Joystick required	$ 12.00	DES
‡‡‡‡‡	Chomper Essentially Pac Man - with the best graphics	Joystick required	$ 12.95	RAC
‡‡‡‡‡	Snakman Fast version of Pac Man	Joystick optional	$ 24.95	MDG
‡‡‡‡	Mad Painter You could call this a 'reverse Pac Man', sort of - but it's fun!	Joystick required	$ 9.95	WUN
‡‡‡‡	BOSS Plays chess with some nice features	8K memory card	$ 39.95	DES
‡‡‡‡	The Cube Simulates Rubik's cube - shows all faces & uses standard notation		$ 15.95	QMX
‡‡‡‡	Lunar Command Rescue Astronauts while flying through tumbling meteor fields		$ 16.00	DES
‡‡‡‡	Night Rider The arcade game 'Night Rider'		$ 12.95	VSI
‡‡‡‡	VIC PICS 19 High resolution pictures for your VIC		$ 18.95	MMA
‡‡‡‡	Sub Chase Drop depth charges from destroyer & avoid mines from submarines	Joystick optional	$ 14.96	UMI
‡‡‡‡	Maze Solve a maze from a rat's eye view	Joystick optional	$ 12.95	VSI

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PET/VIC, continued...

VIC Software - Games and Entertainment

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!!!	Munchmaid Pac Man again	8K ram Joystick req	$ 12.95	WUN
!!!	Space Rescue Go thru lethal maze to save spaceman	Joystick req	$ 9.95	WUN
!!!	Air Strike Drop bombs on a tank - Clean graphics & nice sound		$ 11.00	DES
!!!	Grave Robbers A 'graphic adventure' in a graveyard		$ 13.95	VSI
!!!	Trek The classic 'Startrek' game for the VIC		$ 12.95	VSI
!!!	Rescue From Nufon Go from room to room rescuing people & avoiding aliens	Joystick optional	$ 9.95	NUF
!!!	3-D Labyrinth Go thru Rat's Eye view of a maze		$ 12.00	DES
!!!	City Bomber / Minefield Bomb buildings before you hit them / Deduce where mines are or die		$ 23.95	CSW
!!!	Vic Pack II Slalom/Othello/Meteors - Meteors is by far the best one		$ 24.95	SKY
!!!	Krazy Kong Rescue maidens, hop over barrels and avoid Kong	Joystick optional	$ 9.95	NUF
!!!	Maelstrom Vaguely like 'Centipede'	Joystick required	$ 7.95	CDS
!!!	Quirk Try to get up a maze with a lot of moving holes in the floor	Joystick required	$ 9.95	NUF
!!!	Dodge Car Drive down road and miss stalled cars	Joystick optional	$ 9.95	NUF
!!!	Snake Snake about, growing longer when you eat things	Joystick required	$ 9.95	WUN
!!	Depth Charge Drop those pills on dem submarines		$ 9.95	RAC
!!	Gold Brick Snake about eating gold bricks & avoid self		$ 14.00	DES
!!	Computer Baseball Play baseball by selecting characteristics of players for both teams		$ 11.95	PRS
!!	Cosmic Debris Shoot at downfalling aliens		$ 14.95	VSI
!!	Tank Wars Take out enemy tank who mirrors your moves amid trees, lake, mines	Joystick optional	$ 17.95	HES
!!	Its A Living Catch those bombs from 4 conveyer belts		$ 9.95	WUN
!!	Skiing Ski down hill avoiding trees, ice & eating goodies		$ 9.95	WUN
!!	Skier Ski down a hill avoiding pitfalls	Joystick optional	$ 17.95	HES
!!	Kosmic Kamikaze Shoot at aliens & avoid mother ship	8K ram Joystick opt	$ 24.95	UMI
!!	Super Trek Your basic 'Startrek' in strange colors	8K ram	$ 9.95	TEL
!!	Adventure Pack I Three tiny adventures - not easy!		$ 14.95	VSI
!!	Fuel Pirates This one is simply not describable		$ 15.95	HES
!!	Recreation Program Pack Six games (2 are educational) from Commodore		$ 59.95	CSJ
!!	Escape Get out of rat's eye maze using N S E W		$ 9.95	NUF
!!	VIC Pack III Indi500/Convoy/Gunfight - all ho-hum		$ 24.95	SKY
!!	VIC Trek A minimal 'Startrek' game for the VIC		$ 17.95	HES
!!	VIC Trek Another 'Startrek' - colors used make for hard reading		$ 7.95	CDS
!!	Baseball Strategy Simulate baseball game by choosing type of pitches & batting		$ 12.00	DES

Rating	Product Name / Description of Product	Needs	Price	Mfr. Code
‡‡	Convoy Raider Select strategies as a sub commander attacking convoy		$ 11.95	PRS
‡‡	Boxer's Corner Select qualities of boxers who then slug it out		$ 11.95	PRS
‡‡	Action Games Pack Three marginal games Trap/Seawolf/Bounceout		$ 24.95	CRS
‡	VIC Pack I VicVader/UFO Attack/Slot	Joystick & Vicvader	$ 24.95	SKY
‡	Adventure Pack II Three more tiny adventures - very hard to get out of first room		$ 14.95	VSI
‡	Convoy Escort Converse of Convoy Raider - now you are the escort		$ 11.95	PRS
‡	Star Defender Undynamic simulation of space battles		$ 11.95	PRS
‡	Treasures of The Bat Cave Go around rat's-eye maze looking for gold & avoiding dumb bats		$ 14.95	VSI
‡	VIC-Yahtzee Plays and scores Yahtzee - minimal program		$ 12.00	DES
‡	Gobbler Chase a gobbler - gobble gobble		$ 9.95	DES
‡	Boxing 2 player game - operate boxers		$ 11.00	DES
‡	Tic Tac Vic TicTacToe played perfectly so very boring		$ 9.95	ELC
‡	A Maze Ing Move ball thru lethal maze		$ 12.00	DES
‡	Simon Plays Simon similar to the toy Simon		$ 15.95	HES
‡	Tank Invaders I really don't recall but it was a one star for sure		$ 9.95	RAC
‡	Clowns Move seesaw to bounce clowns to pop balloons		$ 9.95	RAC
‡	Target Zap 'Snake' done crudely		$ 9.95	TEL
‡	Maze of Mikor Get through a maze and find treasure and kill monsters - unfortunately the maze is so dense you don't have a chance at all. Would get 2 or 3 stars if properly tuned ...		$ 17.95	HES
‡	Star Fighter 'Star Wars' in slow time	Joystick required	$ 13.95	MSP
‡	Attack on Silo III Shoot ICBMs at UFOs, slowly		$ 12.00	DES
‡	Lazer Blitz Fly over UFO's & shoot them - the explosions are pretty	Joystick optional	$ 17.95	HES
‡	Pak Bomber 'Ghost' drops eggs which you catch - way too hard to start with		$ 15.95	HES
‡	Pinball Undexterous version of a pinball machine		$ 15.95	HES
‡	Planet Lander Remake of PET Lunar Lander with gravity optional		$ 9.95	COB
‡	Space Lander / Dots White Remake of PET Lunar Lander & a dull game		$ 7.95	DTC
zero	Breakaway Breakout - This one has the distinction of being the only game that requires the CBM paddles. Not that it made much difference - the ball mostly went through the screen's paddle anyways	Paddles required	$ 9.95	TEL
zero	Logic Games Only if you love MasterMind		$ 14.95	CSW
zero	Dungeons of Kal It just didn't work		$ 11.95	PRS
zero	Panzer Attack Shoot at turkeys (I mean tanks, sorry about that)		$ 14.00	DES
zero	Pedestrian Polo This one is definitely a turkey		$ 14.00	DES
zero	Robots It loaded & ran but nothing happened		$ 9.95	RAC

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Figure 3. Who Makes Them.

List of VIC Manufacturers.

Code	Name	Address	City	State	Zip	Phone
ABA	Abacus Software	PO Box 7211	Grand Rapids	MI	49510	616 241 5510
ACS	Academy Software	PO Box 9403	San Rafael	CA	94912	415 479 4703
ALP	Alphacom	2323 South Bascom	Campbell	CA	95008	408 559 8000
AMP	American Peripherals	122 Bangor Street	Lindenhurst	NY	11757	516 226 5849
CAR	Cardco	3135 Bayberry	Wichita	KS	67226	316 685 9536
CAY	Carry-Comp	24687 Aric Way	Elkhart	NY	46517	219 875 8698
CDS	Comm*Data Systems	PO Box 325	Milford	MI	48042	313 685 0113
CBM	Commodore	487 Devon Park Dr	Wayne	PA	19087	215 687 9750
CMT	Computermat	PO Box 1654	Lake Havasu City	AZ	86403	--- --- ----
COB	Computer Barn	319 Main St # 2	Salinas	CA	93901	408 757 0788
CPU	Compute!	PO Box 5406	Greensboro	NC	27403	919 275 9809
CPW	Computer Works	2020 West Camelback	Phoenix	AZ	85015	602 249 0611
CSC	Computer Service Centr	1115 Third St	San Rafael	CA	94901	415 453 6494
CSJ	Commodore Comp Center	930 Twn & Cntry Vill	San Jose	CA	95128	408 246 5710
CSW	Creative Software 201	San Antonio Cir#133	Mountain View	CA	94040	415 948 9595
CWK	Code Works	PO Box 550	Goleta	CA	93116	805 683 1585
DES	Data Equipment Supply	8315 Firestone Blvd	Downey	CA	90241	714 778 5455
DTC	DTC Software	PO Box 916	Janesville	WI	53547	608 752 3434
ELC	Elcomp Publishing	53 Redrock Lane	Pomona	CA	91766	714 623 8314
FSS	French Silk Smoothware	PO Box 207	Cannon Falls	MN	55009	507 263 4821
GCB	Gloucester Comp. Bus	6 Brooks Rd	Gloucester	MA	01930	617 283 7719
HES	Human Engn Software	71 Park Lane	Brisbane	CA	94005	415 468 4110
HYP	Hypertech 1820	NE 143 St Penths 7	Miami	FL	33181	--- --- ----
ISW	Intelligent Software	PO Box 3745	San Rafael	CA	94912	415 459 2905
MCP	Magic Carpet	PO Box 35115	Phoenix	AZ	80569	--- --- ----
MCS	Micro-Systems 11105	Shady Trail #103	Dallas	TX	75229	214 484 7836
MDG	Microdigital	752 John Glenn Blvd	Webster	NY	14580	716 872 0647
MIS	MIS	250 Fern Rock Way	Boulder Creek	CA	95006	408 338 9546
MMA	Midwest Micro Assoc	PO Box 6148	Kansas City	MO	54110	816 921 6502
MSG	Microsignal	900 Embarcadero #A	Goleta	CA	93117	--- --- ----
MSP	Microspec	2906 Ports O'Call Ct	Plano	TX	75075	214 867 1333
MWE	Micro World Electronix	6340 W Mississipi Av	Lakewood	CO	80226	303 934 1973
MWS	MW Software	PO Box 126	Urbana	IL	61801	217 356 7511
NUF	Nufenkop	PO Box 156	Shady Cove	OR	97539	503 878 2113
PAC	Practical App of Calif	PO Box 255768	Sacramento	CA	95825	916 920 1900
PAR	Parsec Research	Drawer 1766-P	Fremont	CA	94538	415 651 3160
PRS	P. R. Software	PO Box 169	S. San Francisco	CA	94080	415 873 6806
PTI	Precision Technology	2970 Richards St	Salt Lake City	UT	84115	801 487 6266
PUD	Public Domain 5025	S. Rangeline Rd	West Milton	OH	45383	513 698 5638
QDI	Quantum Data Inc 3001	Redhill Bld 4 #105	Costa Mesa	CA	92626	714 754 1946
QMX	Qumax - GRW Labs	PO Box 17010	Rochester	NY	14617	716 338 2145
RAC	Random Access Comptrs	PO Box 1453	Destin	FL	32541	904 837 7201
RAK	RAK Electronics	PO Box 1585	Orange Park	FL	32073	904 264 6777
RAR	RAR-Tech	PO Box 761	Rochester	MI	48063	--- --- ----
RRB	RAM/RBC Systems	PO Box 351	Malden	MA	02148	617 324 0559
RVR	RVR Systems	PO Box 265	Dewitt	NY	13214	315 446 8709
SKY	Skyles Electric Works	231-E S. Whisman Rd	Mountain View	CA	94041	415 965 1735
SLA	Slagh System Services	PO Box 53	Dearborn	MI	48121	313 846 6666
SPE	Specific Software	PO Box 10516	San Jose	CA	95157	--- --- ----
SUN	Sunrise Electronics	7957 Lompoc Court	Citrus Heights	CA	95610	916 969 0319
TAY	Taylormade Software	0053 E. Avon Ave	Lincoln	NE	68505	402 464 9051
TEL	Telegames	PO Box 152	Hampton Ontario		L0B 1J0	416 263 0064
TIS	Total Information Serv	PO Box 921	Los Alamos	NM	87544	--- --- ----
TOR	Toronto PET Users Club	381 Lawrence Av West	Toronto Ontario		M5M 1B9	416 782 9252
TSA	TSASA Software	2 Chipley Run	West Berlin	NJ	08091	609 346 3063
UMI	United Microware Ind	3503 Temple Ave # C	Pomona	CA	91768	714 594 1351
VCC	Vic Computing	39-41 North Road	London England	--	N7 9DP	01 607 9489
VSI	Victory Software 2027-A	S.J. Russel Cir	Elkins Park	PA	19117	215 576 5625
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CIRCLE 154 ON READER SERVICE CARD

rings...trs-80 strings...trs-8

Stephen B. Gray

From the 46th floor of the TRS-80 tower, we look out on a famous games graphicist's latest undertaking, a $400 error in a recent column, two games from Liberty Software, more on blank program lines, using the PC-1 Pocket Computer as a portable data-logger, the Radio Shack/CitiLine credit card, Line Printer VIII graphics, and a short program that creates graphics from the keyboard.

Radio Shack Signs Christopherson

Leo Christopherson, one of the top computer-graphics artists in the world of personal-computer games, has taken a leave of absence from teaching to write games for Radio Shack.

Leo is famous for programs that are outstanding for their animated graphics and ingenuity, such as *Android Nim* (June 1979, p. 125), *Cubes* (Aug. 1980, p. 162), *Snake Eggs* (Aug. 1980, p. 162), *Lifetwo* (Aug. 1980, p. 162), *Dancing Demon* (Oct. 1982, p. 178), and *Voyage of the Valkyrie* (June 1982, p. 220).

Leo has been teaching mathematics and "sometimes science" to seventh and eighth graders in a junior high school in the Franklin Pierce School District outside Tacoma, Washington.

For a year, and possibly a second year, Leo will write graphics games, primarily for the Color Computer, working at home at his own pace. "They have left it pretty much up to me, as to what I'll work on," he told me. As part of his contract, Radio Shack donated 17 TRS-80 Model III computers to his school district, to be used in a network arrangement.

Radio Shack had tried in the summer of 1981 to get Leo to write full-time for them, but by then he had already signed his annual teaching contract. They asked again later, and he got a leave of absence. Both Radio Shack and the school district have agreed to a second year of full-time games programming, if Leo wants it.

Radio Shack is not the only computer manufacturer, of course, to offer Leo a job. Atari wanted him to travel around the country, giving lectures and seminars on what an Atari computer can do, but he didn't want to travel that much.

Keep your eyes open for Leo's programs under the Radio Shack label.

$400 Too Much

Somehow the game of *Talking Hangman*, described in the Sept. 1982 column (p. 208), had its price raised from $11 to $411, somewhere in the labyrinth between my printer and the phototype-setting machine. To repeat, it is $11.

Two Games from Liberty

Let's look at the first two programs marketed by Liberty Software Co. (635 Independence Ave., S.E., Washington, DC 20003), which specializes in games and educational programs. The two are games that can be played on either a Level-II Model I or Model III TRS-80 with 16K of memory: *Alien Armada* ($13.95 tape, $17.95 disk) and *Golfer's Challenge* ($13.95 tape). If you can't find these at your local computer store, Liberty can supply them, if you include $2 for shipping and handlng.

Liberty Software, by the way, is the label Acorn Software Products (also of Washington) is now using on games, because Acorn is moving "in the direction of software for more personal use, such as *Superscript* and *Instant Sort/Search Database*," one of their people told me. (Those two Acorn programs will be reviewed here in a few months.)

Alien Armada

This is a fairly standard arcade-type game, where you use the left and right arrows to move the "rocket base" left and right, and the spacebar to fire rockets at the attacking aliens, who drop bombs that can wipe you out (with accompanying sound effects) unless you move fast. If you are quick enough to wipe out the armada, along comes another, and so it continues, one alien fleet after another, as long as you live.

This is a very fast-moving real-time machine language game, for one or two players, requiring concentration and quick reflexes, even at the beginner level. Once you develop some skill, you can move to the two higher levels of difficulty, which are guaranteed to make your heart pound even if you are an expert at such games. Warning: You probably shouldn't play *Alien Armada* if you are not supposed to get excited.

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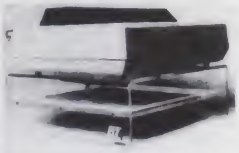

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The kit was designed to be installed by a non-technical person, and takes an average of 45 to 75 minutes to complete. The only tools necessary are a phillips and flat head screw driver and a pair of diagonal cutters. No cutting of traces or soldering is necessary. The full instruction procedure was the topic of a feature in 80 US Magazine in the May, 1982 issue, and was given high marks for ease of installation.

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Golfer's Challenge

This game of golf, for one or two players, generates 18 new holes, complete with sandtraps, waterholes, and trees, every time you play. You have a choice of 13 clubs (a driver, three woods, eight irons and a wedge) and of seven directions to aim the ball.

The holes are drawn for you, as straightaways or doglegs, one at a time, and the display shows the tee, 150-yard distance markers from the hole, various fairway hazards (T for a tree, S for sand, W for water), the green, and a number that represents the distance from tee to hole.

You select a club and direction of aim, using a table that indicates the possible yardage of each. The ball doesn't always go where you want it to, of course. When you get on or near the green, you don't putt; the computer takes over and assigns two or three shots to make the hole. After each hole, a scorecard is displayed.

Sound effects are available through earphones or the recorder AUX jack, and consist mostly of a chirping, accompanied by a flashing pixel, to show where your ball is.

The game is interesting for a round or two, but unless you are a golfer, or want to learn something about the game, or get some pleasure playing this against an opponent, you probably won't play it very long. The graphics are clever, but the ball doesn't sail through the air, and the clubs are never seen on the screen.

Blank Program Lines III

In writing about how to put blank lines between sections of your program listings, the June 1982 column (p. 217) said Radio Shack's Line Printer II ignores down-arrows, and that you must, when using the II or other printers like it, "add spaces the hard way: one at a time."

Don Davidson of Silver Creek, NJ has a marvelously simple solution:

"You had a suggestion for a better way to put blank lines in program listings using the down-arrow. It did not work, however, on a Line Printer II.

"It is almost as easily done on a Line Printer II, though. Just add a space after the down-arrow. For example, to leave two spaces, just add (down-arrow)(space) (down-arrow)(space) at the end of the line."

It works. Of course, after the (down-arrow)(space), you have to press ENTER, to get the prompt for the next line.

PC-1 as Portable Data-Logger

In the PC-2 section of the RSC-7 catalog, it says "Radio Shack will introduce an RS-232C interface and software to allow the PC-2 to function as a terminal." Well, you can get a hardware/software package right now that will let you use the earlier PC-1 Pocket Computer as a portable data-logger.

With the PTR Interface from Protean Scientific (Route 13, Lincoln, NE 68527), you can use the TRS-80 PC-1 to transfer data tapes from the Pocket Computer to a TRS-80 Model I or III. The PTR Interface connects directly to cassette recorder cables of the desktop computer, and doesn't have to be removed during normal cassette operation. An LED flashes to indicate the transfer of data. The interface operates from batteries, and thus cuts down on cable clutter.

The PTR Interface reads both alpha and numeric data, so you can either load datafiles as they occur on the tape, or search for datafiles by name. You can load complete files, or specify the number of memories you want transferred. Checksum errors identify invalid data.

Protean Scientific provides a sample Basic program which calls an assembly-language routine. The PTR package, which is $99.95 plus $2.50 for shipping and handling, includes the assembled electronic interface, a cassette tape with the assembler and Basic programs, and a detailed 15-page user manual. The software works with a Model I or III and is supplied in three versions—for 16K, 32K and 48K systems—on the same tape.

According to a letter from Protean Scientific President Robert K. Nickel, the interface "is essentially the outgrowth of a need we perceived for a low-cost data-logger for geophysical measurements. We believe that there are many possible applications in fields such as geology, archeology, botany, zoology, and agronomy. Virtually any specialized study which involves the collection of data in field or laboratory environments could realize greater efficiency and accuracy by using a pocket computer to record data." There are also, of course, many business uses for a data-logger, such as taking inventory.

Using the PTR Interface

The PTR Interface connects between a cassette player and the cassette port of a TRS-80 Model I or III. The interface modifies the data signals from a PC-1 tape to be compatible with the tape-reading circuit of the desktop TRS-80 and the PTR assembly-language program.

The software consists of two programs, the PTR assembler program which transfers data from the PC-1's data tape to the memory of the desktop computer, and a Basic demonstration program which shows how PTR is called and how the data received from PTR is converted into numeric and string Basic variables. Part or all of the Basic program can be incorporated into your Basic programs.

First you connect the PTR Interface in series with the TRS-80 cassette cable and the earphone jack of the cassette recorder. Using the SYSTEM command, you load whichever version of the PTR assembly language program is appropriate to the memory size of your Model I or III. Then load the Basic program, and make a couple of small changes in the listing, depending on the size of your memory size.

Now you are ready to go. Turn on the interface switch, put a PC-1 data tape in the cassette recorder, and RUN the Basic program. You will be asked to enter the name of the file you want to read, and how many registers you want to read from the data file. Pressing ENTER will *result* in all registers being read.

If you have entered TESTX as the file name, the screen will display

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SEARCHING FOR: TESTX

NO DATA STREAM

until the first file is found. If there are other files on the tape before TESTX, the display will show their names to indicate which files are being skipped and also show the contents of the data registers as they are passed; for example:

SEARCHING FOR: TESTX

SKIPPING: TESTB

+1.782010312D-02

When the desired data file is reached, the display changes to

LOADING: TESTX

meanwhile also displaying an error count and register count. As soon as the file is loaded, the display changes completely, and the register contents are displayed; for example:

REG. 1= SCA5
REG. 2= 3423
REG. 3= 93275

and so on, until the contents of all selected registers are displayed. Errors are flagged and counted.

That is all there is to it; using the PTR Interface is about as simple as possible. The manual explains all operations in a very clear way, and also includes several pages on Theory of Operation, plus a listing of the Basic program, should you want to use it in one of your own programs.

Radio Shack/CitiLine Credit Card

For several months now, there has been a new credit card available "for qualified consumers who want a revolving loan account with Citibank...for big-ticket purchases from Tandy's Radio Shack stores. The card can also be used to purchase financial services," according to the press release.

The new card, called Radio Shack/CitiLine, is said to be the first such national "co-branded" bank card. It is accepted only at Radio Shack stores "in the 48 contiguous states," and is for financing a purchase of $225 or more. Borrowers pay about two percent a month; there is no annual fee.

Now you can get "instant credit" for buying a Radio Shack hi-fi or music synthesizer, or even a TRS-80 computer.

"As a matter of fact, it worked too well—I programmed my income, budget, and expenses and it advised me I couldn't afford *to* own *it!"*

```
10 '----GRAPHICS MODE PRINTABLE DATA IN THE RANGE 129 - 255 ---
20 '-----------FOR TRS-80 LINE PRINTER VIII---------

30 LPRINTCHR$(30);' (END GRAPHICS MODE TO ENABLE LPRINT A)
40 FOR A=129 TO 255
50 LPRINT A; CHR$(18);' (LPRINT A, THEN ENTER GRAPHICS MODE)
60 LPRINT CHR$(255); ' (LPRINTS VERTICAL LINE FOR REFERENCE)
70 LPRINT CHR$(128); ' (LPRINTS SPACE)
80 LPRINT STRING$(10,A);'(LPRINTS 10 DOT LONG STRING OF CODE A)
90 LPRINT CHR$(30); '(END GRAPHICS MODE TO ENABLE LPRINT A )
100 NEXT A
```

```
129 ▔ 130 ▏ 131 ▔ 132 ▏ 133 ▕ 134 ▏ 135 ▔
136 ▏ 137 ▕ 138 ▕ 139 ▕ 140 ▏ 141 ▕ 142 ▔
143 ▀ 144 ▏ 145 ▏ 146 ▕ 147 ▕ 148 ▕ 149 ▕
150 ▕ 151 ▕ 152 ▏ 153 ▕ 154 ▕ 155 ▕ 156 ▔
157 ▕ 158 ▀ 159 ▀ 160 ▏ 161 ▏ 162 ▏ 163 ▏
164 ▏ 165 ▕ 166 ▏ 167 ▕ 168 ▏ 169 ▕ 170 ▕
171 ▕ 172 ▏ 173 ▕ 174 ▏ 175 ▀ 176 ▏ 177 ▏
178 ▏ 179 ▏ 180 ▏ 181 ▕ 182 ▏ 183 ▕ 184 ▔
185 ▕ 186 ▕ 187 ▕ 188 ▔ 189 ▕ 190 ▀ 191 ▀
192 ▏ 193 ▏ 194 ▏ 195 ▏ 196 ▏ 197 ▕ 198 ▏
199 ▀ 200 ▏ 201 ▕ 202 ▏ 203 ▕ 204 ▏ 205 ▕
206 ▏ 207 ▀ 208 ▏ 209 ▕ 210 ▕ 211 ▕ 212 ▕
213 ▕ 214 ▕ 215 ▕ 216 ▏ 217 ▕ 218 ▕ 219 ▕
220 ▏ 221 ▀ 222 ▀ 223 ▀ 224 ▏ 225 ▏ 226 ▏
227 ▏ 228 ▏ 229 ▕ 230 ▏ 231 ▏ 232 ▏ 233 ▕
234 ▕ 235 ▕ 236 ▏ 237 ▕ 238 ▕ 239 ▀ 240 ▔
241 ▏ 242 ▏ 243 ▕ 244 ▏ 245 ▕ 246 ▕ 247 ▀
248 ▔ 249 ▏ 250 ▏ 251 ▕ 252 ▔ 253 ▀ 254 ▀
255 ▀
```

Line Printer VIII Graphics

Last month's column featured Radio Shack's dot-matrix Line Printer VIII (p. 306), which offers proportional spacing, elongated or condensed characters, underlining, superscripts, subscripts, and many more features, including 30 graphics characters.

Each of the 30 characters consists of six vertical dots in various combinations, which the printer manual says can be used "for drawing pictures, figures, or graphs." Fifteen of the characters are four small squares in all their combinations (the last of which is a larger square), eleven short lines and sets of intersecting lines that can be used to construct forms, and four triangles that face in different directions.

Bill Fronek, of Houston, TX, sent the above program and RUN to give some idea of what can be done with columns of dots, but in this case, it's all possible combinations of seven dots.

Line 50 puts the printer in graphics mode, which is a bit-image printing mode, and thus quite different from the character printing mode ordinarily used. In graphics mode, printable data must be in the range 128-255; you can print any combination of seven dots in a dot column. Each dot is controlled by one bit in the data byte, in which the high bit (value 128) is always on, so that, in effect, the printout above represents the binary numbers 1 through 127.

Line 80 prints a 10-dot-long string of columns. Note that, if you select the right dot combinations, and string them together properly, you can create almost any dot-matrix character you wish, from foreign alphabets to tiny pictures.

The catch with trying to print the 30 graphics characters referred to above is that the manual doesn't tell you how to do it. There is a table of printing codes, but these codes range between 225 and 254, which are the same codes used for bit-image printing. The Line Printer VIII manual is highly frustrating, to say the least.

Short Program #34: Keyboard Graphics

A letter from Cincinnati includes a program for the Model-I Level-II computer:

"Did you know that it is possible to place graphics on the screen from the keyboard? The following program is one method of doing it and can be used in all sorts of games.

```
5 CLS: PRINT
10 INPUT "ENTER A NUMBER
   BETWEEN 64 AND 69"; X
15 CLS: PRINT
20 B$=INKEY$
30 PRINT CHR$(ASC(B$)+X); " ";
40 GOTO 20
```

"This program gives you direct control over 58 of the graphics characters at one time, using shifted and unshifted entries (there is a total of 63 graphics characters). In this range of X, all of the letters of the alphabet give graphics as well as (sometimes) # @ = ?<>. I would appreciate knowing if someone can figure out how to control all of the characters."

If you have written a game or two using INKEY$, you may realize, without running this program, that it won't work. It was typed, and since few of us are great typists, extra care must be taken when typing up a program instead of using a printer.

RUN this program, and you get

?FC IN 30

or on a Model III,

Illegal function call in 30

which may, of course, lead you to think something is wrong with line 30. What's that pair of double-quotes for? Nothing, apparently, so take them out. And you get the same error message.

If you assume the error is in line 30, you might pare the problem down to what may seem the heart of the problem:

20 B$=INKEY$

30 PRINT ASC(B$)

Run this and you'll get the same error message, which is somewhat mystifying because, according to the Level II manual, this pared-down version of line 30 is OK.

So, finally, you look at page 5/5 of the Model II manual (page 166 of the Model III manual), and you find, "INKEY$ returns a one-key string determined by an instantaneous keyboard strobe. If no key is pressed during a strobe, a null string (length zero) is returned....Because of the short duration of the strobe cycle (on the order of microseconds), INKEY$ is invariably placed inside some sort of loop, so that the keyboard is scanned repeatedly."

After reading the rest of the text about INKEY$, you soon realize all you need add to the Cincinnati program to make it work is a simple loop:

25 IF B$="" THEN 20 ELSE 30

Mystery: What was the original, working version of the Cincinnati program? Was the one-space string at the end of line 30 originally part of something like line 25? What do the two PRINT statements do for the program?

Enter a 64 after you RUN the program, and keys A-Z plus # and @ will give you a total of 54 graphics characters, with the graphics codes 129-156 and 160-186. That's using the SHIFT key, too.

If you enter a 69 after you RUN the program, you shift the "window" five places to the right, so to speak (so to write?), and by using keys A-Z plus = @<>? @ you obtain 59 graphics characters with codes 129-160 and 165-191. That takes care of all 63, counting the other set also.

So what the last sentence in the Cincinnati letter must mean is: Can you write a program that will generate all 63 graphics characters from the keyboard, without having to use ENTER or anything similar in line 10? The answer involves a knowledge of ASCII codes below 32, and between 91 and 95, inclusive. Assuming, of course, that there is a program that will do the trick. □

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Steve Gray, et al.

A Practical Introduction to Computer Graphics, by Ian O. Angell. John Wiley & Sons, New York. 154 pages, paperback $16.95. 1981.

This slim British book provides a quick but thorough look at computer graphics for those familiar with college-level math and Fortran. It moves fast: page two presents a simple program (and then a shorter version) for drawing a square, shows the results, then asks the reader to "draw a triangle, a pentagon and a hexagon with programs similar ,to those above."

The programs are not explained, perhaps because the additional text would add several dozen pages to the book, which is expensive enough as it is. There are dozens of Fortran programs in the ten chapters, on 2-D graphics, 2-D matrices, clipping and covering, 3-D coordinate geometry, 3-D matrices, perspective and stereoscopic views, hidden-line algorithms, setup techniques, computer movies, projects, and a conclusion. Exercises are scattered throughout the book, but no answers are provided.

On page 10, Angell gets into vector pairs, by page 26 into matrices, and by 43 into direction cosines. So you'd better have a good grounding in math, or be prepared to learn a lot. The author writes clearly, with a lean style that concentrates on the essentials. An example: "There need only be three basic forms of coordinate-system change; that is, translation of origin, change of scale, and rotation of axes; all other changes can be formulated in terms of these three types."

The book "is essentially a third-year degree course given to undergraduates at Royal Holloway College, University of London," and as with nearly all Wiley books, is very nicely produced, with clear program listings, very neat drawings, and much attention paid to typography. If you are interested in computer graphics, have a good enough background in Fortran to convert the programs to Basic or whatever language you are using, and can cope with matrix determinants, you will find this book a valuable introduction.

Excuse Me, What Was That? Confused Recollections of Things that Didn't Go Exactly Right, by Anton Braun Quist. Dilithium Press, Beaverton, OR. 1982.

My experience has led me to believe that humor books of this sort have a common tendency: a majority of them are not very amusing. This book is an exception, and a notably witty one. It is a compendium of some bizarre and ostensibly true goings on in the realm of men and machines. Dilithium Press should do itself a favor, however, and retitle the book. Something like "Technological Tangles" would probably fill the bill.

Rather than restricting itself to computer tales, the book approaches many aspects of technological *faux pas*, ranging from lens-making to flying, even driving a bus. Quist attests to the veracity of every story he presents, and Dave Ahl has confirmed the truth of at least one of the stories.

Each tale underscores the author's philosophical bent, namely, that "there's a touch of panic in all human endeavor, a drive to be mysterious that flavors all action, and has not yet been accounted for in formulas for predicting results."

views...book

Rings true, doesn't it? Otherwise stated, "you never know until later."

Take the example of the R&D group that wanted to print on strawberries. Marketing studies have shown that the word "Sunkist" sells citrus fruits. If only, the innovators mused, they could do the same for the strawberry. A promising electrostatic process was developed, similar to Xeroxing, wherein ink powder could be accurately put on nearly anything. "Indeed, Time Magazine ran a picture of a label that had been put on a raw egg on a plate. (No, not on the shell, on the raw yolk and white lying right there on the plate.) 'We can print on still water,' said the proud innovators who had developed the basic technology."

The only problem was they had no way to *affix* the powder to the medium. A Xerox machine uses heat to fuse the powder. Certainly this couldn't be done to a strawberry. The developers dabbled with all sorts of fixes, but they couldn't get the powder to stay. No matter what. Case closed.

Then there was the outfit that turned out the traveling wave tubes, very crucial to radar technology. One day they simply lost the ability to turn out working tubes, and understandably, began to panic. An extensive evaluation was made of assembly line practices. Rigid standards were enforced. Still, no tubes would work.

Finally it was determined that production stopped just when a female employee left the company. They feverishly brought her back. She began creating working tubes.

It seems she used her thumbnail as a guide when inserting elements into the tube. "They used a micrometer on her thumbnail, prepared a gauge of the same thickness, and used it to make traveling wave tubes that worked. So much for science."

How about the secret ingredient used to make electric eyes? Government officials couldn't make them work without it. The solution finally came out, for bladder or worse.

I'm a sucker for stories like this, and the book is chock full of them. There is something recognizable in the dirigible tester who can't seem to get hydrogen to burn until he blows himself up, or the computer that works phenomenally until the moment it's on TV. Truth is that superstition still lives, and those closest to technology know this best. For some great stories documenting the "dark side of the force," this book is great.—JJA

Fun With Microcomputers and Basic, by Donald D. Spencer. Reston Publishing Co., a Prentice-Hall Co., Reston, VA. 128 pages, paperback $9.95. 1981.

This "new version" of *Fun With Computers and Basic*, originally published in 1977, is described by Reston as "an excellent book for children." But not much younger than teenage; the vocabulary is fairly sophisticated.

After introductory chapters on the Importance of Computers, How to Recognize a Computer, Telling the Computer What to Do, and Let's Talk in Basic, the book gets down to its major theme with a 70-page chapter on Problems and Programs. A nine-page glossary ends the book.

The change in title reflects the note in the preface that the programs in the current book were developed using TRS-80

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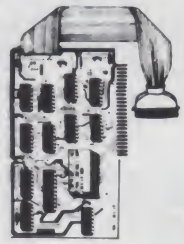

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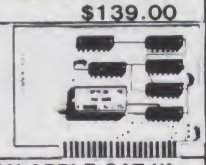

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and Apple computers, and will run on many others.

Almost fifty programs are included in the long chapter, starting with simple ones such as metric conversion and grade average, and working up to complex programs such as Magic Square and Buried Treasure. Many interesting programs are provided, such as Armstrong numbers, perfect numbers, coin-tossing, and slot machine.

Every few programs, the author asks the reader to write one or more on his own, building up to more and more complicated ones, such as Wheel of Fortune.

Written with Spencer's usual straightforward style, and enlivened with dozens of drawings and cartoons, this book is very good for a beginner of almost any age, from the teens on up, who's interested in learning how to program by first copying a few programs from the book, seeing how they run, and then writing a couple on his own. No solutions are provided in the back of the book.

Introduction to Interactive Computer Graphics, by Joan E. Scott. John Wiley & Sons, New York, NY. 265 pages, hard-cover $24.95. 1982.

Although the preface says "this book combines in a single volume both technical information about graphics systems and practical knowledge concerning their use," the emphasis is almost entirely on "what" and not "how." There are no programs, no program lines, and very few equations.

However, there is much of interest here for those who want a good but quick look at what can be done with computer graphics. There are hardware chapters on Input Devices at the Work Station (light pens, digitizers, joysticks, trackballs, dials, keyboards, buttons, switches, voice data-entry), Interactive Display Devices, Lasting Results (plots, hard copy, photographs), Graphics Suppport; software chapters on Building the Computer Model, Interactive Input Techniques, Viewing the Computer Model, 3-D Viewing, Application Programs; and two final chapters, on Management Concerns, and Application Survey.

Most of the hardware chapters, and one of the software chapters, provide a vendor list for the products described, and there is a 38-item list of references for those wishing to delve further into various topics, although only one is dated after 1978, and that is Newman and Sproull's 1979 *Principles of Interactive Computer Graphics* (reviewed March 1980, p. 184), a better and more extensive book (from McGraw-Hill), with more than twice as many pages for the same price, although with math you would have to have a graduate degree to understand. There is a little advanced math in Scott's book, but almost entirely in the chapters on Viewing the Computer Model, and 3-D Viewing.

Scott's book is good, as far as it goes, with a good coverage of the subject, although with many extraneous words and too-long sentences. Newman and Sproull's book is hard to beat; Scott's is something like a subset of it.

The TRS-80 Means Business, by Ted G. Lewis. John Wiley & Sons Inc., New York. 203 pages, paperback $12.95. 1982.

One of the latest in Wiley's paperback guides to microcomputers, this one claims to be "the first introduction to computing with the best-selling TRS-80 Model II microcom-

puter that's geared specifically for business users," according to the back cover.

Chapter 1 asks Who Needs a Small Computer?, and discusses several examples in detail. Chapter 2, Computer People Talk Funny, looks at hardware and software. Chapter 3, Who Can Afford a Computer?, examines system costs. The next three chapters present programs, in The Computer as Filing Cabinet (file structures), Instant Retrieval Techniques (hashing), and The Little Databaser. Chapter 7, Analysis of Small-Business Systems, "ties together many of the concepts and techniques developed throughout the previous chapters," in looking at systems for dentist's billing, shoe-store accounts payable, stockbroker's files, etc. An admirable 22-page appendix on Getting Started With Model II Basic provides a cookbook, from turning on the power switch to editing to Basic statements to data types.

The author's teaching experience (in Computer Science at Oregon State University) is evident in his carefully detailed presentation of complex principles in an easily understood fashion. The book, however, is best understood by a fairly bright reader, especially the chapter on hashing, which may be a problem to those who didn't do well in high school or college algebra. For those who did, this book is highly recommended.

An 8" disk of all the programs in the book is available from the publisher for $19.95.

More TRS-80 Basic, by Don Inman, Ramon Zamora and Bob Albrecht, John Wiley & Sons Inc., New York. 285 pages, paperback $9.95. 1981.

One of the latest in the Wiley STG (Self-Teaching Guide) series, this sequel to the authors' *TRS-80 Basic* book "helps you build on your fundamental knowledge of Level II Basic with scores of practical applications that are both recreational and educational. It explains all TRS-80 Level II Basic statements, commands, and features not covered in their previous best seller," according to the back cover.

The book explores PEEK and POKE, several different ways of displaying graphics (including "super-graphics" techniques), and file-handling using both cassette and disk files.

The chapters include an Introduction, Guided Tour of Memory (RAM, ROM, PEEK, POKE), Graphics and Super-graphics (SET, RESET, POKE, STRINGS$), Introduction to Cassette Data Files, More about Cassette Files, Disk Operation, Using Disk Files, Tuning Up Your Computer (adding sound to programs), Special Features and Fancy Functions (saving memory, error-handling, etc.), Graphics and Animation, Arithmetic Functions, and A TRS-80 Art Lesson. Three appendixes provide a table of graphics characters, information on the cassette recorder, and error codes and messages.

Written with the well-known expertise of these veteran authors, the book explains everything in detail, with many programs and drawings. Like its predecessor, this book is also available from Radio Shack, at the same price, with a different cover (showing the Model III) and title, "Advanced Level II Basic."

These two books are what Radio Shack should have provided with the Level II TRS-80 instead of that reference manual. □

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THE CREATIVE APPLE, edited by Mark Pelczarski and Joe Tate. 8½" x 11", softcover, illustrated, 450 pp. **$15.95.**

THE CREATIVE ATARI

is an invaluable guide for the average, non-expert user who knows a little about BASIC and simple programming. The Atari is one of the most sophisticated consumer graphics devices ever invented. Yet, because it *is* so powerful, learning how to use its special features can be difficult for all but the most skilled programmers. Here's where THE CREATIVE ATARI can help. Taking articles, columns and tutorials that previously appeared in *Creative Computing*, the authors have updated the material for maximum learning ease. THE CREATIVE ATARI contains four main sections:

- An introduction, with a discussion of Atari memory concepts essential to programming.
- A tutorial on Atari graphics.
- A collection of programming tips, plus information on non-graphics areas.
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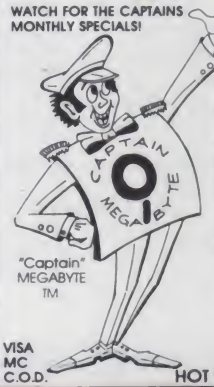

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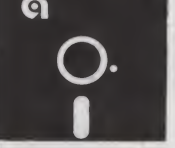

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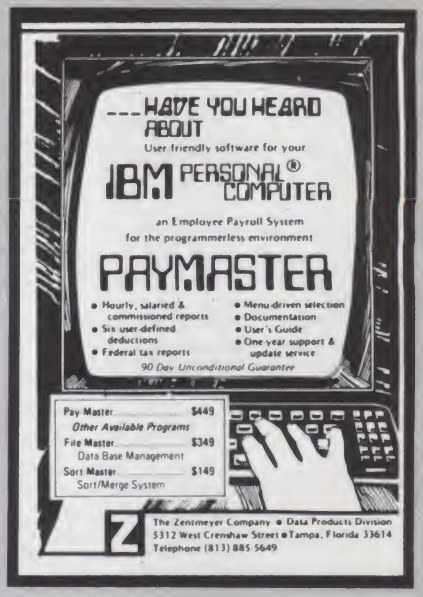

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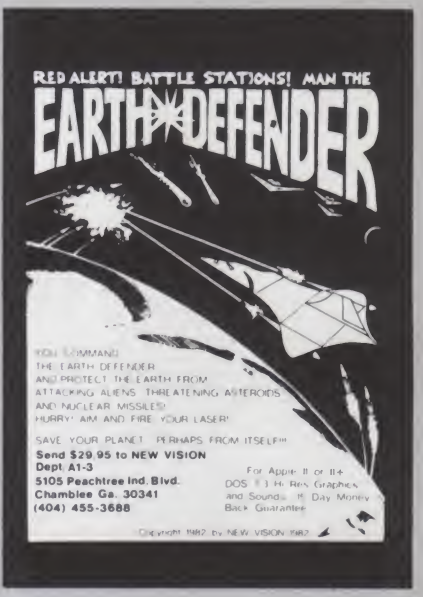

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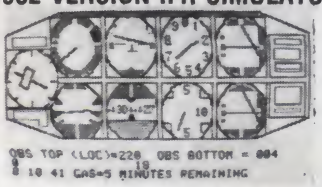

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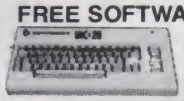

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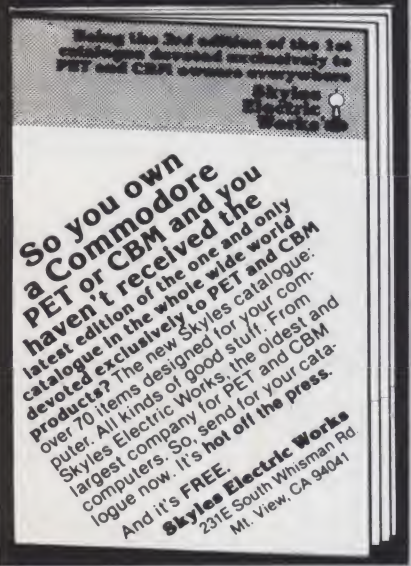

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index to advertisers

Reader Service No.	Advertiser	Page
101	A2D Company	238
102	Aardvark Technical Services	51
103	Accent software	118
104	Advanced Operating Systems	189
105	Adventure International	110-111
106	ALF Products	82
107	The Alien Group	375
108	Alpha Byte Computer Products	206-207
109	Alpine Software	175
110	Alternative Software	94
111	Amdek Corporation	228
112	Apple Computer Corp.	102-103
113	Applied Software Technology	210
114	Archive	317
115	ARCsoft Publishers	225
116	Ark Computing	70
*	Artworx	146
*	Aspen Software	323
119	Associated Research Enterprises	416
118	Atari	112
120	Automated Simulations	211
117	Automated Simulations	27
121	Avalon Hill Company	185
122	B.A.S.F. Computer	25
123	BBI Mail Order	367
124	Beagle Brothers Micro Software	246-247
125	Big Five Software	13
126	Bit 3 Computer Corporation	295
127	Bottom Line	315
128	B.P.I. Systems	178
129	Broderbund Software	186-187
130	BT Enterprises	410-411
131	Business Machine Consultants	398
132	Calsoft	125
133	Central Point Software	8
134	Charles Mann & Associates	234
135	Chatsworth Data	255
136	Christin Industries, Inc.	262
137	Chromanetics Corporation	226
138	Chromasetts Magazine	286
139	CJM Industries	18
226	Cleveland Consumer Computers & Components	347
140	C-Load Magazine	287
141	Collins International Trade Corp.	241
142	Commodore Business Machines	Cov 3
143	Communications Electronics	181
144	CompuServe	154-155
145	Compushack	296-297
146	Computer Discount of America	255
370	Computer-Ed	341
147	Computer Exchange	40-41
165	Computer Learning Tree	238
148	Computer Mail Order East/West	282-283
149	Computer Outlets	279
150	Computer Plus	349
151	Computer Specialties	303
152	Computertime, Inc	371
153	Computer's Voice	365
154	Computer Warehouse	407
155	Computer World International	257
156	Computronics	293
157	Comstar	26
158	Connecticut Information Systems	92
159	Consumer Computer Mail Order	335
160	Control Data	132-135
166	Corona Data	2
161	Cosmic Computer's Unlimited	19
162	Cottage Software	238
167	Covercraft	61
163	CPU Shop	143
*	Creative Software	130
164	Creativity Unlimited	366
168	Curtis Manufacturing	363
169	Dakin 5	11
170	Datamost	54
171	Datamost	55
172	Datamost	56
173	Datamost	57
174	Datasmith	347
175	Davidson & Associates	377
176	DDL Software	398
197	Decision Support Software	377
374	Decision Support Software	377
178	Dickens Data	18
*	Digital Equipment Corporation	122-123
179	Dilithium Press	359
180	Discount Data Products	106-107
181	Don't Ask Computer Software	183
182	D/Punch Company	405
183	Dresselhaus Computer Products	234
184	Dynacomp	274-275
185	800 Software	49
187	Educational Activities	236
188	Educational Activities	347
189	Educational Audio Visual, Inc.	361
186	E&L Instruments	68
190	Electronic Specialists	356
191	Epson America	176-177
365	Excalibur Technologies Corp.	74
372	ExecSystems Software	404
192	First Star Software	121
193	Floppy Disk Services	339
360	Focus Media	129
195	Formaster	31
196	Franklin Computer	109
219	Gamestar	202
177	Genie Computer Corporation	104
228	Gladstone Electronics	366
200	Gold Disk Software	242
201	Great Plains Software	145
222	Happy Hands	340
203	Hayden Software	53
*	Hayden Software	269
204	Hayes Microcomputer Products	46
*	Heath Company	115-117
205	Huntington Computing	309
206	IBM Corporation	172-173
207	IJG Computer	32
208	IJG Computer	205
*	Infocom	140-141
209	I/O Management	335
210	Jade Computer Products	265-267
211	JDR Microdevices	277
212	Kelly's Computing	251
213	Kensington Microware	90
214	Kensington Microware	258
215	Kern Publications	213
216	Krell Software	72
217	Krell Software	50
199	Leading Edge	9
218	Leading Edge	Cov 4
220	Learning Tools, Inc.	401
221	Little, Brown	357
202	LNW Research	17
223	LNW Research	380
224	Lowerne Ltd.	405
225	Lyco Computer	413
227	Mail Comp	272
198	Maxell	5
229	Meridian	342
230	Micro Business World	261
373	Micro Computer Service Center	416
371	Microcomputer Technology Inc	227
231	Micro D	23
232	Micro House	28-29
233	Micro Lab	127
234	Micro Learningware	280
235	Micro Management Systems, Inc	355
236	Micromint, Inc	361
257	Micro Mountain	169
239	Microsystems Exchange	174
240	Micro Systems Software, Inc	409
272	Micro Systems Software, Inc	192
238	Micro-Systems	369
241	Microware Dist. Inc	417
242	Micro Works	353
243	M-R Information Systems, Inc.	405
245	Muse Software	128
246	Muse Software	260
247	National Software	88
248	NEC Information Systems, Inc.	191
249	Neeco	319
251	Newport Machine Design	210
250	Nexa Corporation	263
*	NRI Schools	65-67
252	Odesta	131
255	Omega Microwave	362
254	Omega Microwave	325
283	Omega Microwave	136
287	Omega Sales	252
237	Omni Resources	96
259	Optimized Systems	280
260	Optoman Consumer Products	401
261	Orange Micro	76
262	Pacific Exchanges	280, 365, 367, 398
263	Pacific Polytech	255
264	Pan American Electronics	367
265	Pathway Software	377
266	Peek & Poke Software	377
267	Penguin Software	224
268	Peripherals Unlimited	34
269	Perry Oil & Gas	333
270	Personal Computer Age	327
271	Picadilly Software Inc	60
272	Powersoft	192
273	Practical Peripherals Inc	Cov 2-1
274	Professional Software	305
277	Professional Software	307
278	Program Store	239
280	Programmer's Institute	174
281	Programmer's Institute	357
282	Programmer's Institute	359
253	Prometheus Products Inc	149
285	Protecto	419
284	Protecto	203
289	Quinsept	210
369	Qume	208
245	Racet Computes Ltd	245
291	Radio Shack	197
292	Ranco Software Games	358
293	Reader's Digest	229
294	Red Baron	222-223
296	Redgate Publishing	215
297	Reston Publishing Co.	86
298	R.H. Electronics	217
299	R.H. Electronics	35
300	Rock-Roy, Inc.	218
301	Roland Corp US	324
302	Royal Softouch	372-373
303	Royal Software	52
305	Savvy	198
358	Scitor	349
307	Sculpture By Softouch	403
308	Sensible Software	351
309	S.G.C.	291
258	Sierra On-Line, Inc.	69-101
310	Silicon Valley	231
311	Sirius Software	38
312	Sirus Software	271
275	Sir-Tech	151
276	Sir-Tech	153
313	SJB Distributors	63
314	Small Systems Engineering	235
315	Smith Corona	78
316	Soft Images	157
317	Soft Images	159
318	Soft Images	161
319	Soft Images	163
320	Software City	385
321	Software City, Inc.	244
279	Software Dimensions	232
323	Software Galore	325
324	Softwareland, Inc.	240
325	Software Models	358
326	Software Publishers	371
327	Software Street	361
328	Software Tree	400
329	Southern California Research Group	230
330	Southwestern Data	248
331	Spinnaker Software	14-15
332	SRA	340
333	SRA	341
334	SRA	397
335	Standard & Poor	98
336	Star Micronics	80
337	Sterling Swift Pub. Co.	371
338	Stoneware, Inc.	84
339	Stoneware, Inc.	152
340	Strategic Simulations	139
341	Strategic Simulations	201
342	Strictly Software	301
295	Sublogic	43
343	Sublogic	212
344	Success Sellers	399
345	Suntronics Co., Inc.	174
346	SuperSoft	193
347	Symtec	403
348	Syntax Newsletter	299
349	Systems 4 Limited	285
350	Tech Data Corporation	365
350	Tech Data Corporation	365
351	Techcom Enterprises	333
352	Tecmar Inc	7
353	Texas Computer Systems	418
354	Texas Instruments	166
*	3 G Company, Inc.	356
355	Thunderware	171
368	Timex	44-45
356	Timex	165
304	TSK Electronics	221
357	Unicomm	253
306	Val Par	21
359	Van Horn Office Supply	349
194	Videx	36-37
361	Virtual Combinatics	62
362	Virtual Combinatics	64
363	VR Data	253
364	Wadsworth Electronic Pub. Co.	331
366	Yacaipa Software	333
367	Zor Khan Industries	366

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